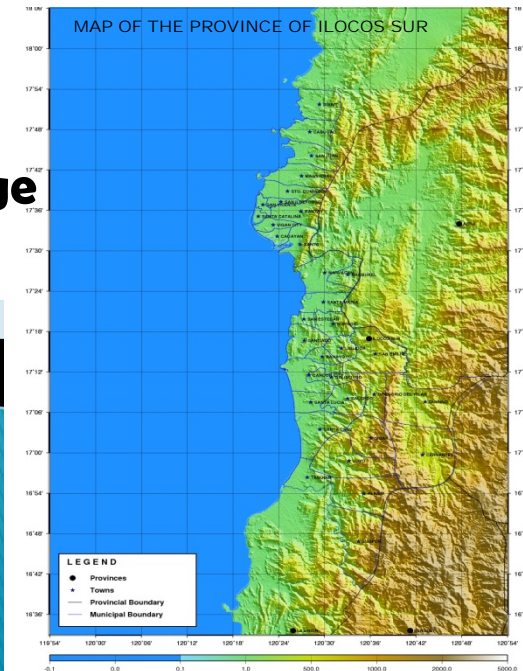


# Earthquake Risks Estimation: A Case of Rapid Earthquake Disaster Assessment System (REDAS) Application in Northern Philippines

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**May 15-18, 2017**



# RATIONALE

- The Islands of Philippines straddles the western fringes of the Pacific Ring of Fire.
- According to National Geographic Society, the Ring of Fire is a string of volcanoes and sites of seismic activity, or earthquakes. Roughly , 90% of all earthquakes occurred and 75% of all active volcanoes on Earth were dotted.
- the country has experienced more than 106 earthquakes with a magnitude of 6.0 or higher since 1600.



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# RATIONALE

- Ilocos Sur is located along the western coast of Northern Luzon
- Bordered by Ilocos Norte to the north; Abra, Mountain Province, and Benguet to the east; La Union to the south, and the China Sea to the west
- 32 municipalities and 2 cities
- 18 of which are located in coast line of China sea
- Total population of 658,587 in 2010



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# RATIONALE

- According to Quakebulletin.com, a total of 152 earthquakes was recorded that occurred in Ilocos Sur, Philippines and vicinity since 1900.
- Of this number, the deadliest earthquakes took place in the last 50 years includes the **July 16, 1990**.
  - Particularly Baguio City and Cabanatuan City
  - 7.9-magnitude earthquake.
  - At least 1,200 people died from the quake.



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# RATIONALE

- The probability of these destructive earthquakes occurring again in the future is indeed very strong that could bring tragedy to the natural and man-made environment and can cause extensive economic losses and social disturbances.
- Rapid Earthquake Damage Assessment System (REDAS) offers a rapid estimate of the possible seismic hazards and the severity of the impacts to population, buildings, lifelines, road networks and other elements-at- risks.
- This study aimed to estimate earthquake risk using the Rapid Earthquake Damage Assessment System (REDAS) in Ilocos Sur, Philippines.



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# METHODOLOGY

## ➤ Capacity Building

- Training-workshop on the use of the Rapid Earthquake Damage Assessment System (REDAS) Software and Android EDM to ensure proper manipulation of software and reliability of impact assessment data produced.
- Spearheaded by the project staff from Isabelia State University and Philippine Institute of Volcanology and Seismology (Phivolcs).



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# METHODOLOGY

## ➤ Site selection and validation

Surveyed Barangay	Classifications
Cabaroan, Sta. Maria	Residential
San Pedro, Candon	Residential
San Antonio, Candon	Mixed
San Juan, Candon	Mixed
Barangay 1, Vigan City	Commercial



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# METHODOLOGY

## ➤ Data Collection

- Ten (10) commissioned enumerators were trained and deployed to facilitate the building survey.
- Coordination in the city local government unit as well as in the barangay offices was carried out before the conduct of enumeration.
- Android phones equipped with android EDM application were used to gather information.
- Total enumeration was employed in all pilot barangay.



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# METHODOLOGY

## ➤ Exposure Database Development

- Exposure, sometimes referred to as the elements at risk
- Area-based approach was adopted in Exposure database development.
- The database composed of building information such as coordinates, floor area, number floors, building class, era of construction and number of occupants.
- Developed database was integrated in the REDAS software as seat of the information in estimating impacts due to earthquakes.



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# METHODOLOGY

## ➤ Risk Calculation and Loss Estimation

- The equations to calculate risk and estimate loss due to earthquakes are set or imbedded in the REDAS software.
- The Ground Shacking tool under Seismic Hazard Assessment Menu was set to estimate the impact of a 7.2 magnitude earthquake.
- The Parameters used were: Longitude of Epicenter is  $120^{\circ} 08' 24''$  and Latitude of Epicenter is  $17^{\circ} 21' 07.92''$ , the depth of earthquake is 10 km with bidirectional movement. The Peak Ground Acceleration (Hard Soil) and Richer method for intensity conversion were used to estimate the impact.



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# Findings:

## ➤ Characteristics of Pilot Barangay

- **Number of Surveyed Households**

1447 building structures surveyed in five pilot barangay in the province of Ilocos Sur

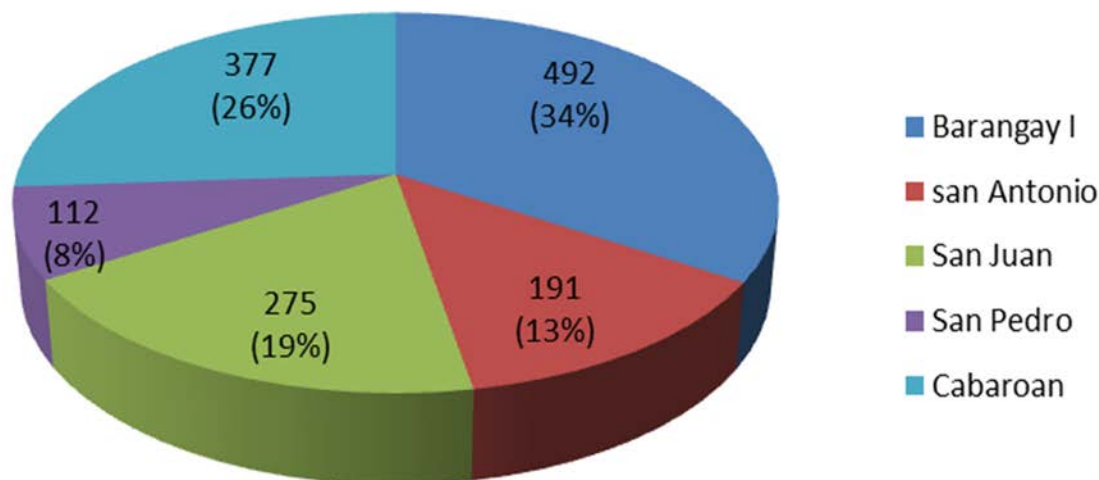


Figure 1. Distribution and number of surveyed households

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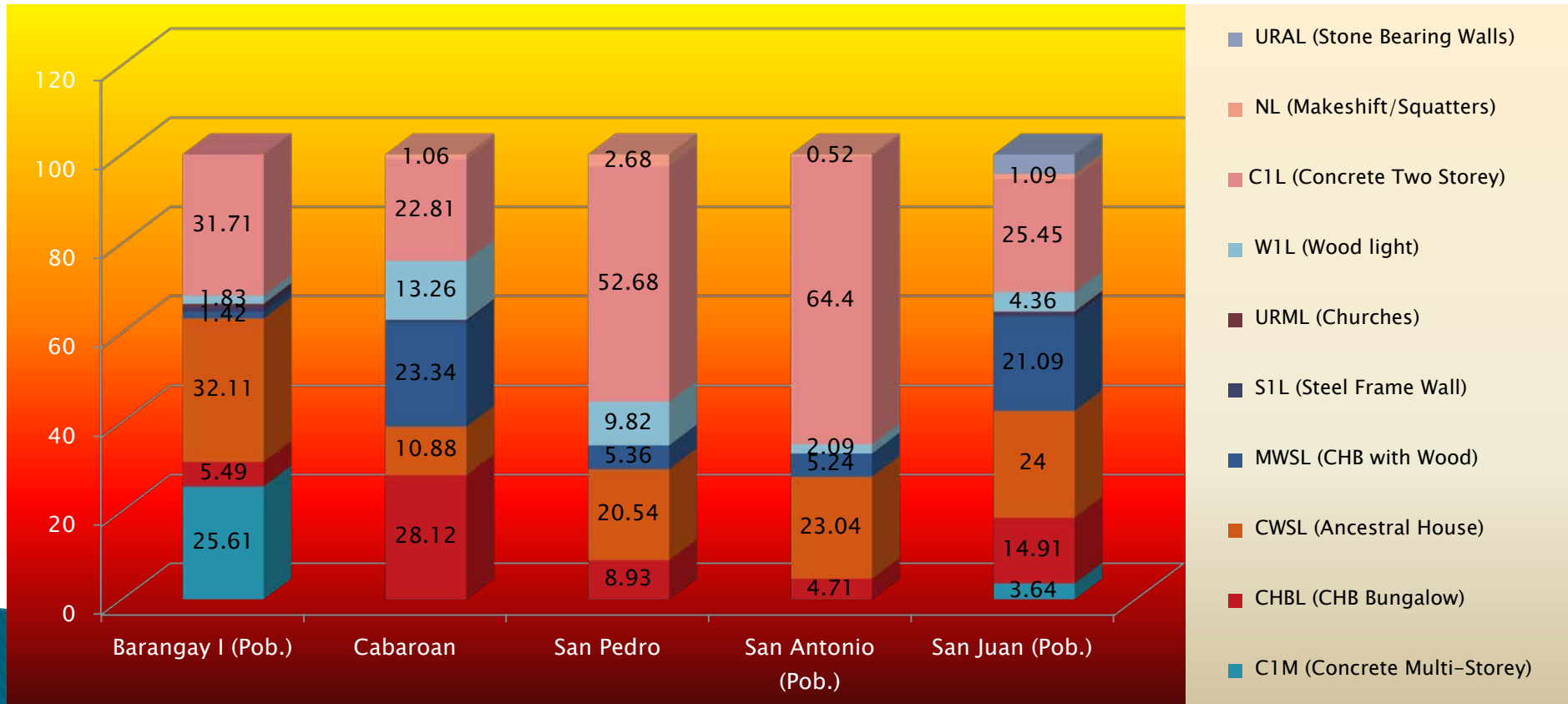




# Findings:

## ➤ Characteristics of Pilot Barangay

- Structural type

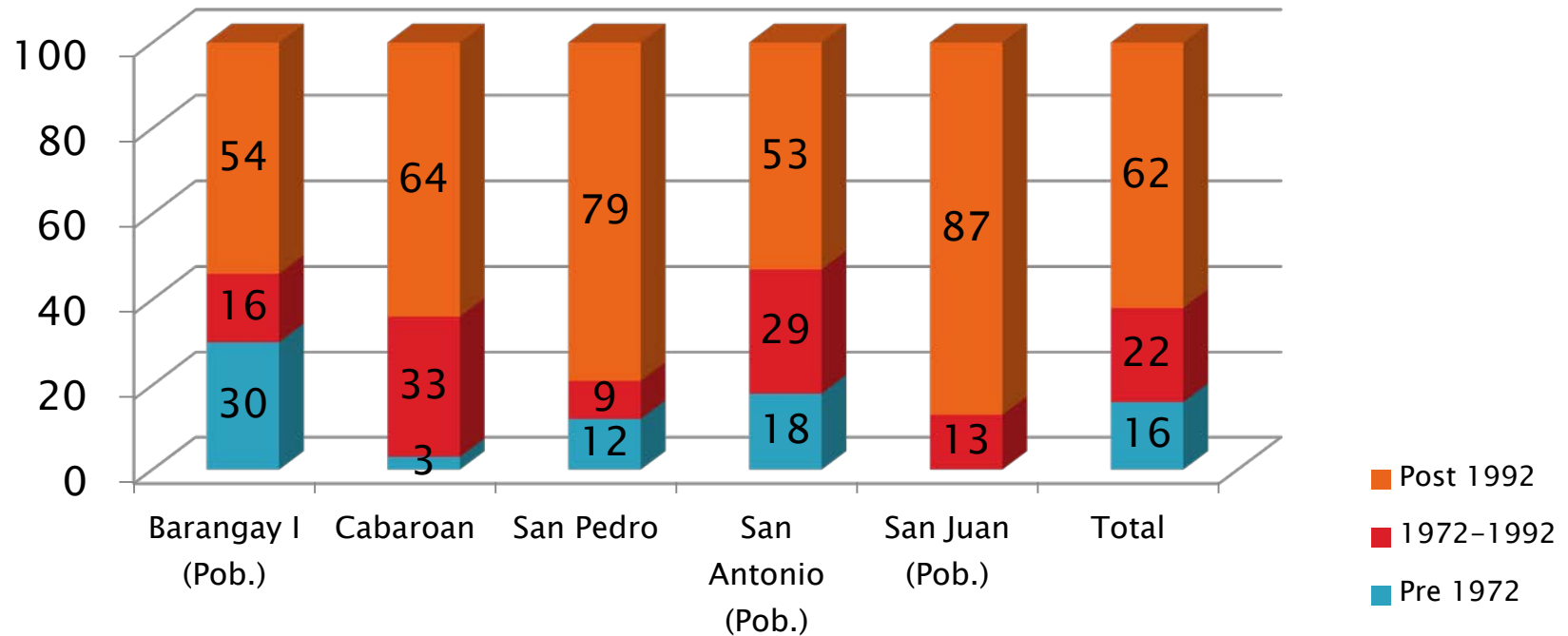


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# Findings:

## ➤ Characteristics of Pilot Barangay

- Era of Construction

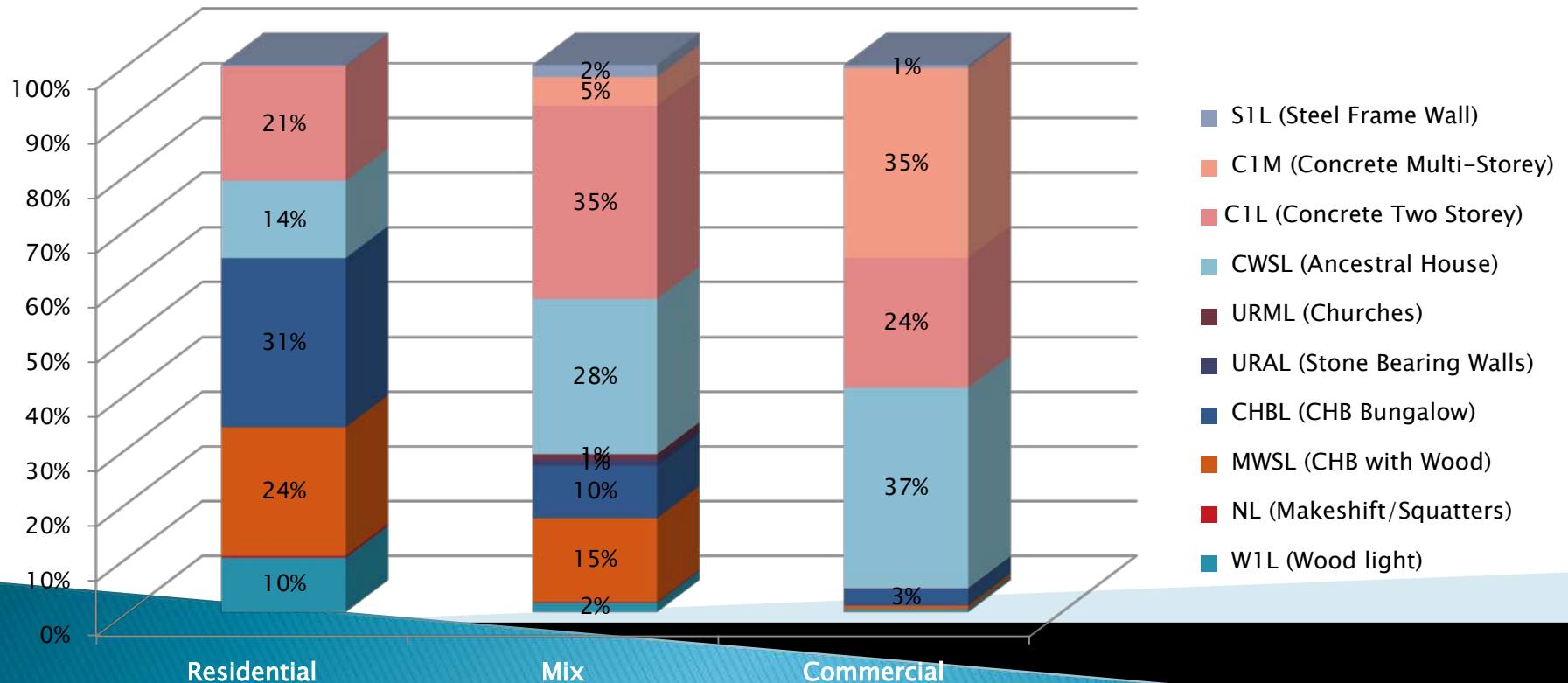


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# Findings:

## ➤ Exposure Database Development

- Floor Area Percentage



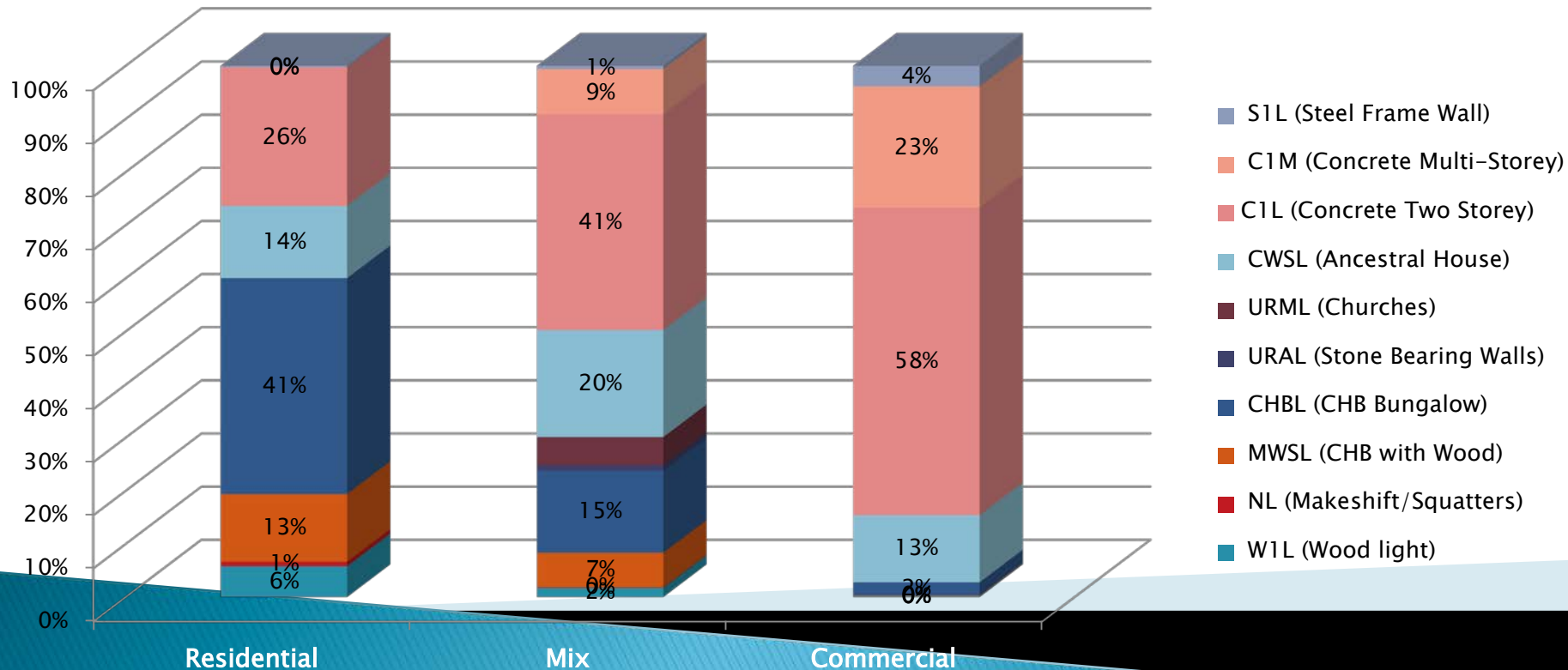
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# Findings:

## ➤ Exposure Database Development

- Population Distribution

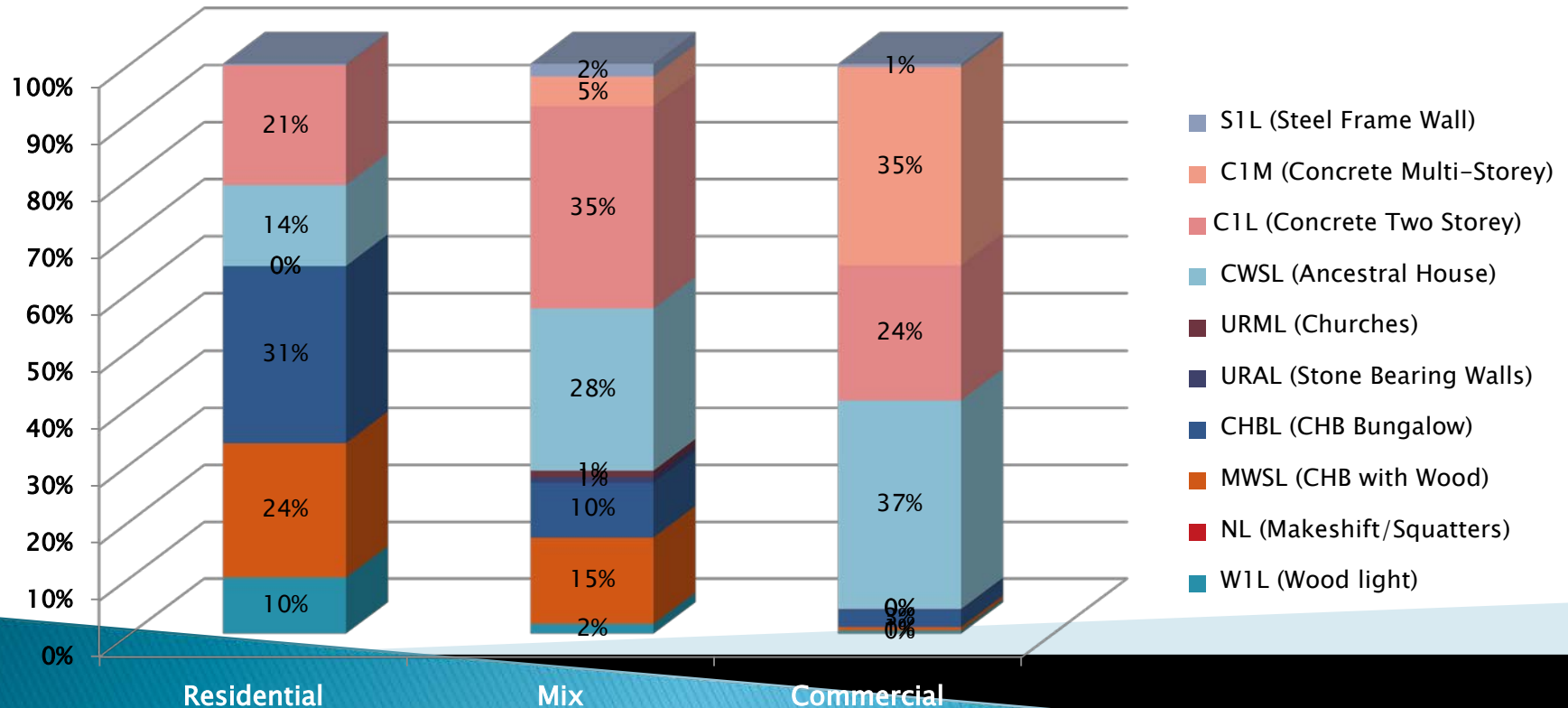


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# Findings:

## ➤ Exposure Database Development

- Structural Type Ratio



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# Findings:

## ➤ Estimated Impact of M7.2 Earthquake

Damages	Slight	Moderate	Extensive	Complete	Collapse
Number of buildings	29226	40613	38400	33376	3000
Total floor area	1599234.6	2242471	2138769	1869707	167482.2

CASUALTIES			
Minor Injury	Serious Injury	Very Serious Injury	Fatalities
16623	3613	122	601

<b>Possible Economic Loss Of Province of Ilocos Sur (in Millions)</b>	<b>= 39112</b>
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# Conclusion:

- Rapid Earthquake Damage Assessment System (REDAS) program can provide rapid estimate of the possible seismic hazards and the severity of the impacts to population, buildings, lifelines, road networks and other elements-at- risks.
- The province could suffer 134,615 building and 8,017,663.8 m<sup>2</sup> floor damages with 20,959 casualties and economic loss of more than 39 billion pesos
- The possible impact in terms of building damages, casualties and economic losses must be disseminated in local government

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## ➤ **Philippine Institute of Volcanology and Seismology (Phivolcs)**

## ➤ **The REDAS Team**

Program Leader: Maria Leonila P. Bautista

Project Leaders: Bartolome C. Bautista (Software Development), Ishmael C. Narag (Tsunami Modeling), Arturo S. Daag (Landslide Hazard Modeling), Ma. Lynn P. Melosantos (Liquefaction Hazard Modeling) and Angelito G. Lanuza (Ground Shaking Modeling)

# MAP OF PROVINCE OF ILOCOS SUR

