

# The Basic Process of Developing Exposure Data

This section provides examples of the data fusion and sampling process. This will include using the host countries census data, OSM data, and site surveys. In addition, challenges to developing exposure will be discussed- such as the inference of building exposure below the census level. The audience will leave with an understanding of how exposure data is developed, what needs to be collected, what the challenges are.

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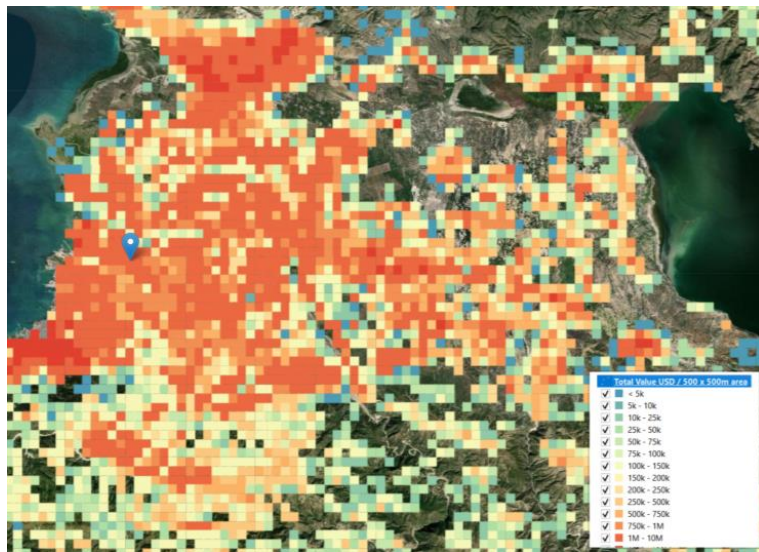


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# How is exposure data developed?



Collect census data



Estimate building attributes



Refine spatial distribution



Estimate number of buildings



Estimate replacement value

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# Collecting census data

- Collect census data
  - Population census
  - Housing census
- Extrapolation to current values
- Importance of high resolution (tract or ward)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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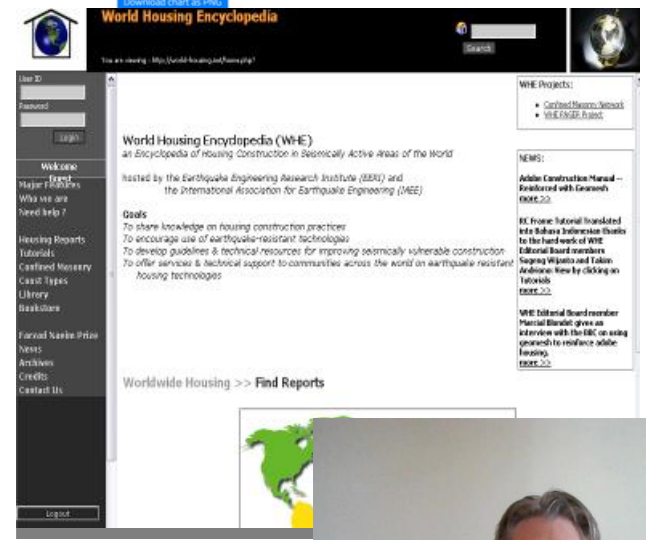
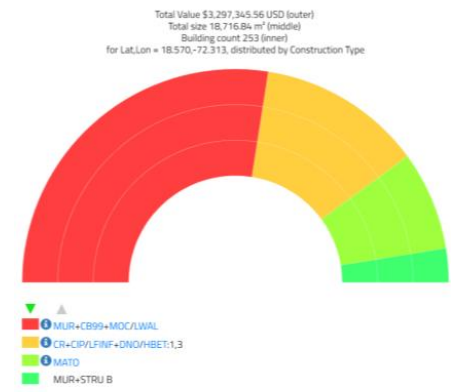


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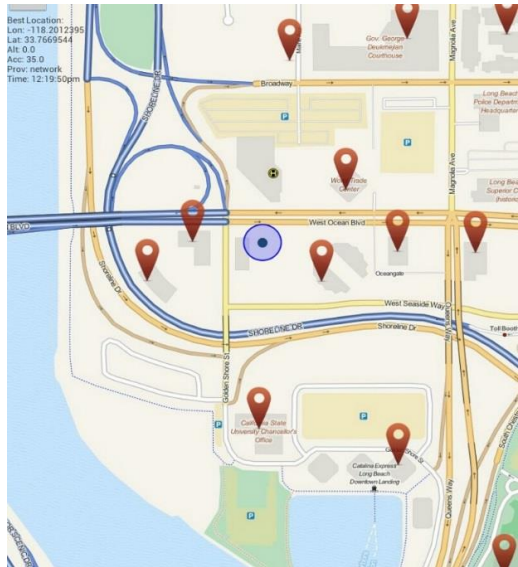
# Estimate building attributes

- Use housing census
- Literature review of predominant building construction types
- Interpretation of satellite data
- Expert opinion
- Virtual reconnaissance
- Site surveys
- Stratified sampling



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# Collecting the data

- Field tools
  - IDCT
  - OSM
  - Field Notes Pro
- Geotagged Photos
- Paper surveys
- Ideal to link back to footprints

Commercial  
Industrial  
Agricultural  
Education  
Emergency Services

Manufacturing  
Petrochemical  
Resort  
Port  
Power generation

Number of stories: (1,2,3 etc): 2

Year of construction

pre-1955  
1955-1971  
1971-1983

1983-1991  
1991-2002  
2002-present

Structure Type

Reinforced Concrete

Frame  
Shear wall  
Precast frames  
Unknown

Timber /Wood

Open frame at grade  
Shear wall at grade  
Dwelling anchored at grade  
Dwelling elevated on piers or stilts  
Unknown

Steel

Moment frame  
Braced frame  
Light frame (transverse-frame; longitudinal-steel rod tension-only bracing)  
Unknown

Masonry

Rubble stone, field stone  
Adobe (earth brick)  
Simple stone  
Massive stone  
Unreinforced, with manufactured stone units  
Unreinforced, with reinforced concrete floors  
Reinforced masonry  
Confined masonry (within a reinforced concrete frame)  
Unknown

Longitudinal

Material Type

Masonry, confined  
Masonry, reinforced  
Earth, unknown reinforcement  
Earth, unreinforced  
Earth, reinforced  
Wood  
Other material

Material Tech

Concrete blocks, solid  
Concrete blocks, hollow  
Masonry unit, other  
Earth technology, unknown  
Rammed earth  
Drib or wet construction

Mortar Type

Lime mortar  
Cement mortar

Masonry Reinforcement

Reinforced concrete bands  
Steel reinforced



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## Results from field surveys: Mapping Schemes

Building Counts and Floor Area (Sq M) by Land Use, Number of Stories and Structural Type

Zone Land Use	Basic Structural Type	Detailed Structural Type	Stories	# of Buildings	Total Sq Meters
Airport	Reinforced Concrete	Frame	1	20	15,000
Commercial	Masonry	Confined masonry	1	861	173,413
Commercial	Masonry	Confined masonry	2	270	173,616
Commercial	Masonry	Reinforced masonry	1	175	37,352
Commercial	Masonry	Unreinforced clay brick	1	2151	303,389
Commercial	Masonry	Unreinforced clay brick	2	97	35,452
Commercial	Masonry	Unreinforced, with reinforced concrete floors	2	97	41,191
Commercial	Reinforced Concrete	Frame	1	451	105,211
Commercial	Reinforced Concrete	Frame	2	296	387,201
Commercial	Reinforced Concrete	Shear wall	1	77	12,214
Commercial	Reinforced Concrete	Shear wall	2	146	57,050
Commercial	Timber/Wood	Open frame at grade	1	886	118,346
Commercial	Other	Other		171	173,692
Industrial	Masonry	Confined masonry	1	849	171,021
Industrial	Masonry	Reinforced masonry	1	849	181,263
Industrial	Reinforced Concrete	Frame	2	562	735,185
Industrial	Steel	Braced frame	1	280	134,875
Industrial	Steel	Braced frame	7	1	8,784
Industrial	Steel	Light frame (transverse-frame; longitudinal-steel rod tension-only bracing)	1	562	762,777
Industrial	Steel	Moment frame	1	280	58,204
Industrial	Steel	Moment frame	2	280	48,667



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Remote sensing example: Typical Midrise Residential in China



- Large residential apartments up to eight stories
- Typically constructed of unreinforced brick walls with concrete floor and roof diaphragms.
- Observed RC frame with URM infill in newer buildings as well as typical soviet bloc construction



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# Don't go overboard



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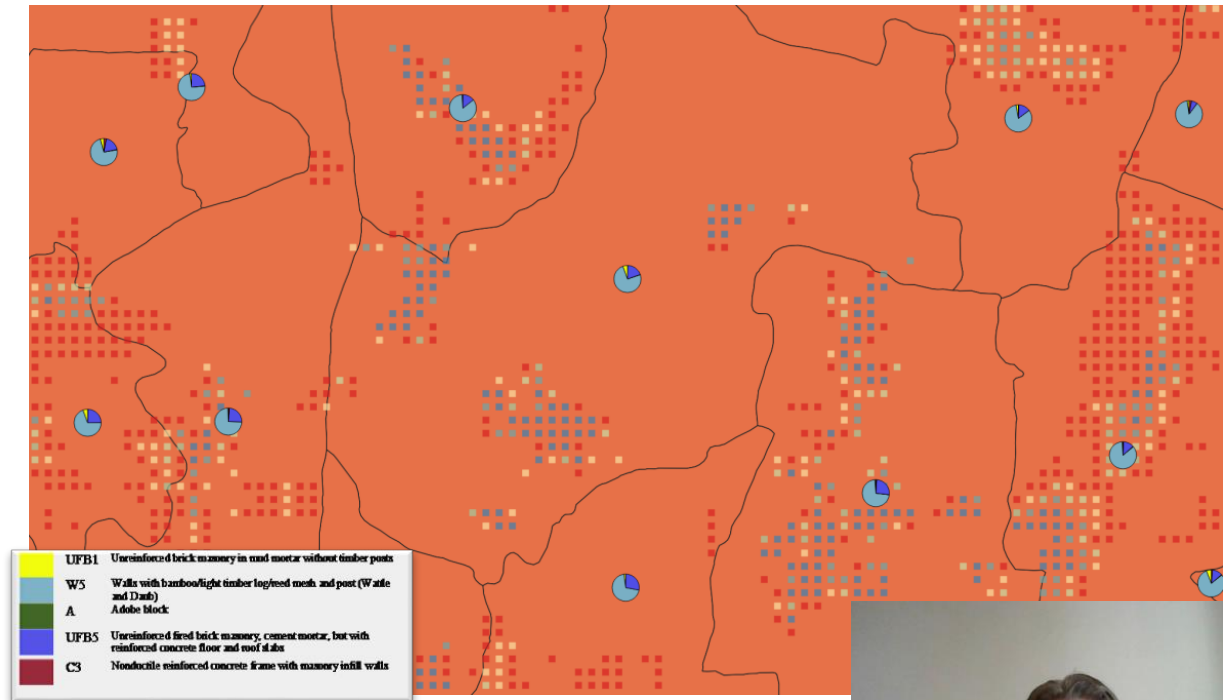
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# Refine spatial distribution

- Dasymetric mapping
- Exclude green areas, water
- Interpolation
- EO-based weighting



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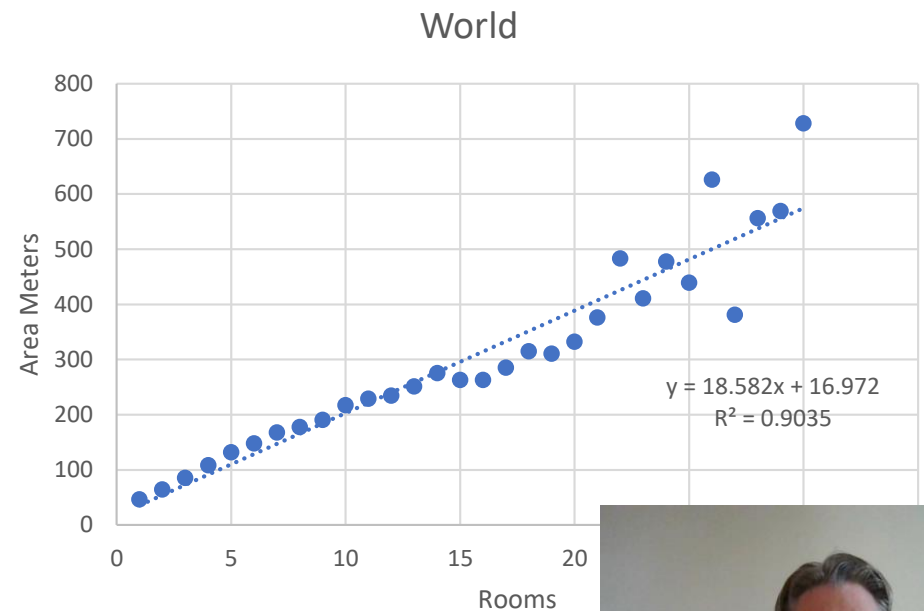
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# Estimate number of buildings and square footage per building

- People Per Household and Households per building
- Building density by key EO factors
- OSM building data footprint
- Height profiles
- Microcensus
- Population density can correlate



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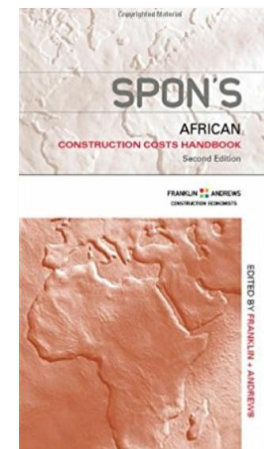
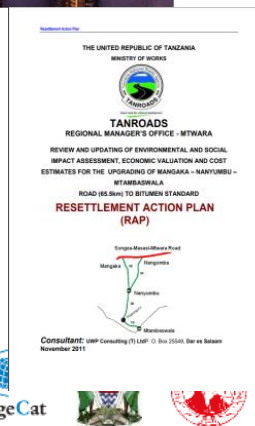
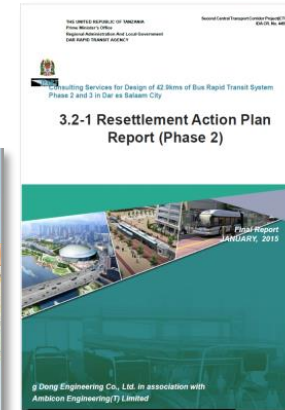
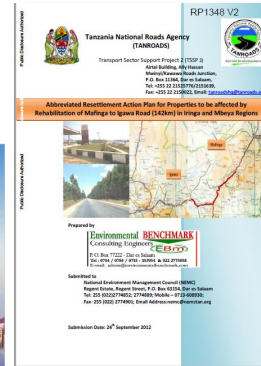
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# Estimate replacement value

- Estimate square footage per building
- Building value per meter by building type or occupancy
- Building construction manuals
- Expert opinion
- GDP/median income
- Scale by building durability
- Difficult to estimate “replacement cost” in some developing countries
- Not always meaningful



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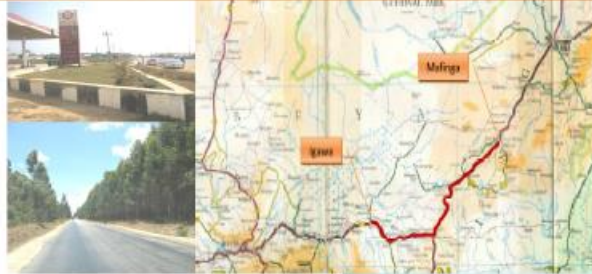
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RP1348 V2



Abbreviated Resettlement Action Plan for Properties to be affected by  
Rehabilitation of Mafinga to Igawa Road (142km) in Iringa and Mbeya Regions



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# RAPs: fair price, negotiated.

Appendix 1: Detailed Valuation Analysis of 17 Properties to be affected by Rehabilitation of Mafinga-Igawa Road (142km) in Iringa and Mbeya Regions

S/N	PICTURE & VAL CODE	OWNER'S PARTICULARS OWNER'S NAME	LOCATION	GENERAL DESCRIPTION BUILDING	VALUATION ANALYSIS			BUILDING VALUE	ALLOWANCES					
					AREAS (MG)	RATIOS (%)	VALUATION		ACCOMMODATION	TRANSPORT	DISTURBANCE	TOTAL COMPENSATION		
1				part of front elevation of petrol station that includes concrete base, steel works and sign board to be removed at an offset of 3m from the road shoulder	Chaff works Chaffbuilding Total BFA Construction rate per square meter Current Replacement Cost	1,968.0 100% 1,968.00 50,000.00 68,233,000.00								
				Property type: petrol station	Less: Depreciation	20%	13,680,000.00							
				TOTAL			64,720,000.00					2,736,000.00	67,456,000.00	
2				residential building covered with grasses and constructed using mud and wattle. An offset of 5m is used to provide 22.5m corridor of road reserve	Main building Chaffbuilding Total BFA Construction rate per square meter Current Replacement Cost	36.0 100% 36.00 13,000.00 369,000.00								
				Property type: residential	Less: Depreciation	50%	210,300.00							
				TOTAL			258,700.00	72,000.00	100,000.00	1,291.00		441,215.00		
3				part of front elevation of petrol station that includes chaff works and underground fuel tank base to be removed at an offset of 3m from the road shoulder	Chaff works Chaffbuilding Total BFA Construction rate per square meter Current Replacement Cost	28.0 100% 28.00 50,000.00 1,450,000.00								
				Property type: petrol station	Less: Depreciation	20%	280,000.00							
				TOTAL			1,170,000.00					56,000.00	1,226,000.00	
4				A residential building covered with corrugated iron sheet and constructed using burnt bricks and mud. An offset of 5.4m is used to provide 22.5m corridor of road reserve. It is in fair condition	Main building Chaff building Total BFA Construction rate per square meter Current Replacement Cost	48.0 100% 48.00 52,400 100,000.00 9,040,000.00								
				Property type: residential	Less: Depreciation	50%	1,512,000.00							
				TOTAL			9,228,000.00	240,000.00	100,000.00	1,764,000.00		6,184,000.00		
4				A residential building covered with corrugated iron sheet and constructed using burnt bricks and mud. An offset of 5m is used to provide 22.5m corridor of road reserve. It is in fair condition	Main building Chaff building Total BFA Construction rate per square meter Current Replacement Cost	10.0 100% 10.00 100,000.00 1,000,000.00								
				Property type: residential	Less: Depreciation	50%	300,000.00							
				TOTAL			300,000.00							

