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A Design Tool for Risk Reduction in Learning Facilities:

Earthquake and Tropical Storm Prone Areas

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Abstract

This research thesis seeks to provide a tool that could be affectively used when building educational structures in vulnerable areas affected by multiple hazards around the globe. The first chapter introduces the reader to the topic of natural hazards, their impact and the key terminology with a deeper outlook on the deadliest global hazards in the past 20 years – earthquakes and storms. The following chapter was done in a collaboration with our colleagues, Juan Benavides and Erika Cerra, in which a tool was developed in order to assist NGOs (Non-governmental organisations) or CBOs (Community-based organizations) in choosing the most adequate building components with respect to the specific site characteristics, climate and hazard/s affecting the area where a school is needed, maximizing the participation and use of the community's capacity. The hazards developed by the authors in the matrix tool are earthquakes, floods, cyclones and diseases. Finally, in the third chapter, the tool is applied in one of the most multi hazard prone and vulnerable countries – Haiti. This thesis was done as a collaboration between Jana Tosheva and Andrea Matevska.

The primary aim of this thesis was to examine the nature of schools in hazard prone areas and to explore hazards and the factors which impacted upon the construction performance as well as interaction with the communities. Hazards only become disasters when human lives are lost, and livelihoods damaged or destroyed.

While we entered the research context with a clear framework for investigation based on a global level, the research was not focused on testing of any hypothesis or theory in terms of efficiency of different guidelines for hazard resilient buildings which were used as a starting point for the development of our tool – The matrix. The initial purpose of this tool was to reveal and describe the possible solutions for a hazard safe classroom, in order to gain greater understanding for the site characteristics, local materials as well as building techniques which can be used by the communities affected.

WHERE TO BEGIN?

THE COMMUNITY OF PETIT-TROU-DE-NIPPES IS AFFECTED BY STORMS, EARTHQUAKES, FLOODS AND DESEASES.

Now we know which solutions to prioritize

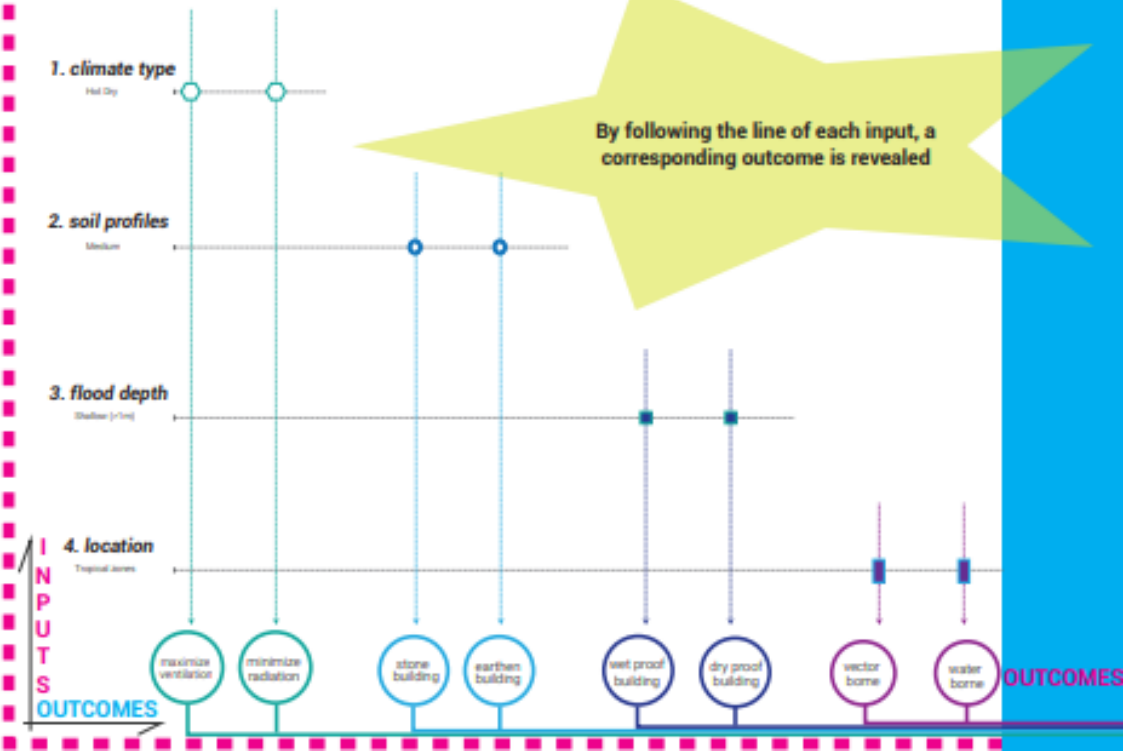
1
RANKING METHOD

2
INPUTS
site characteristics

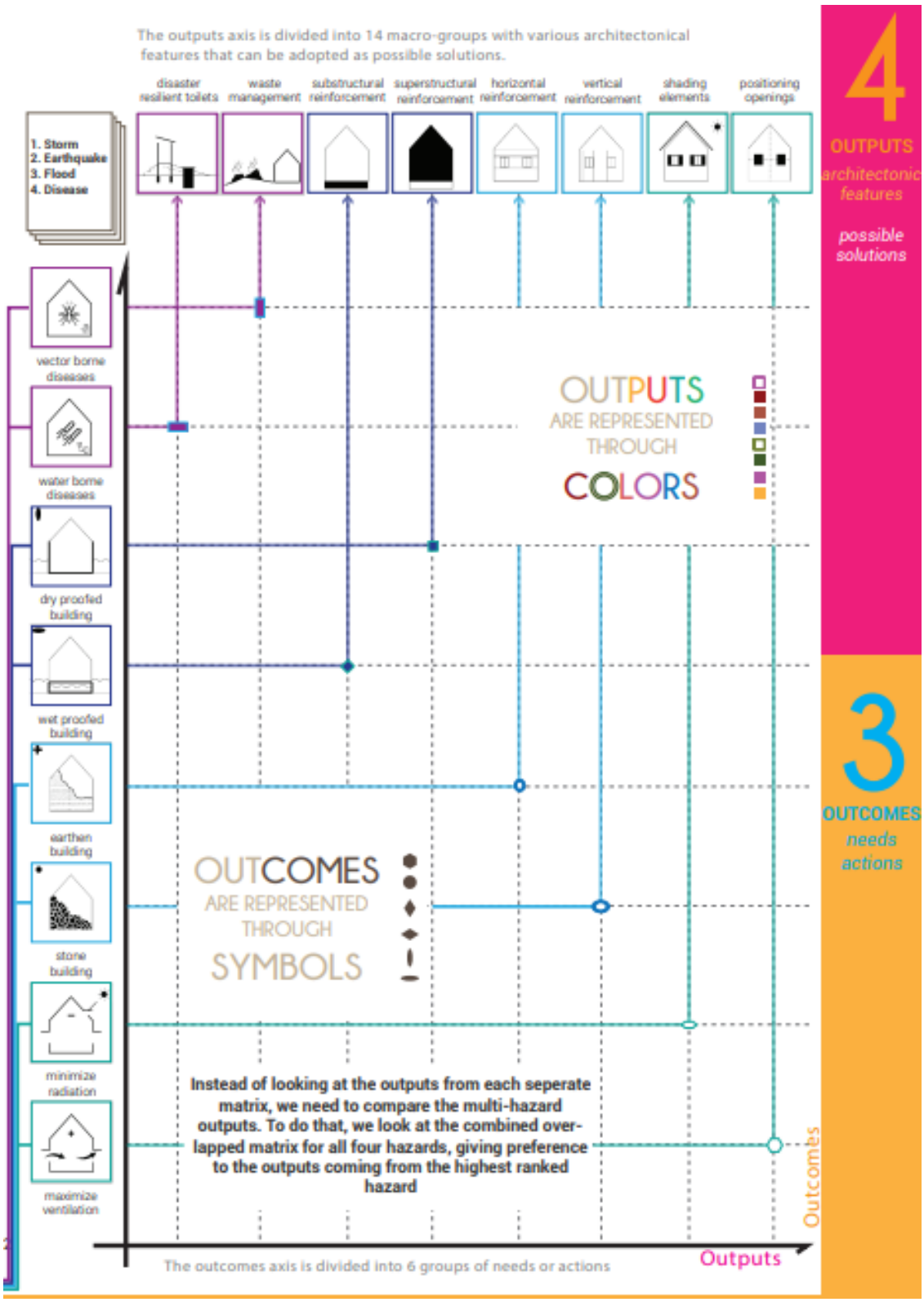
INPUTS

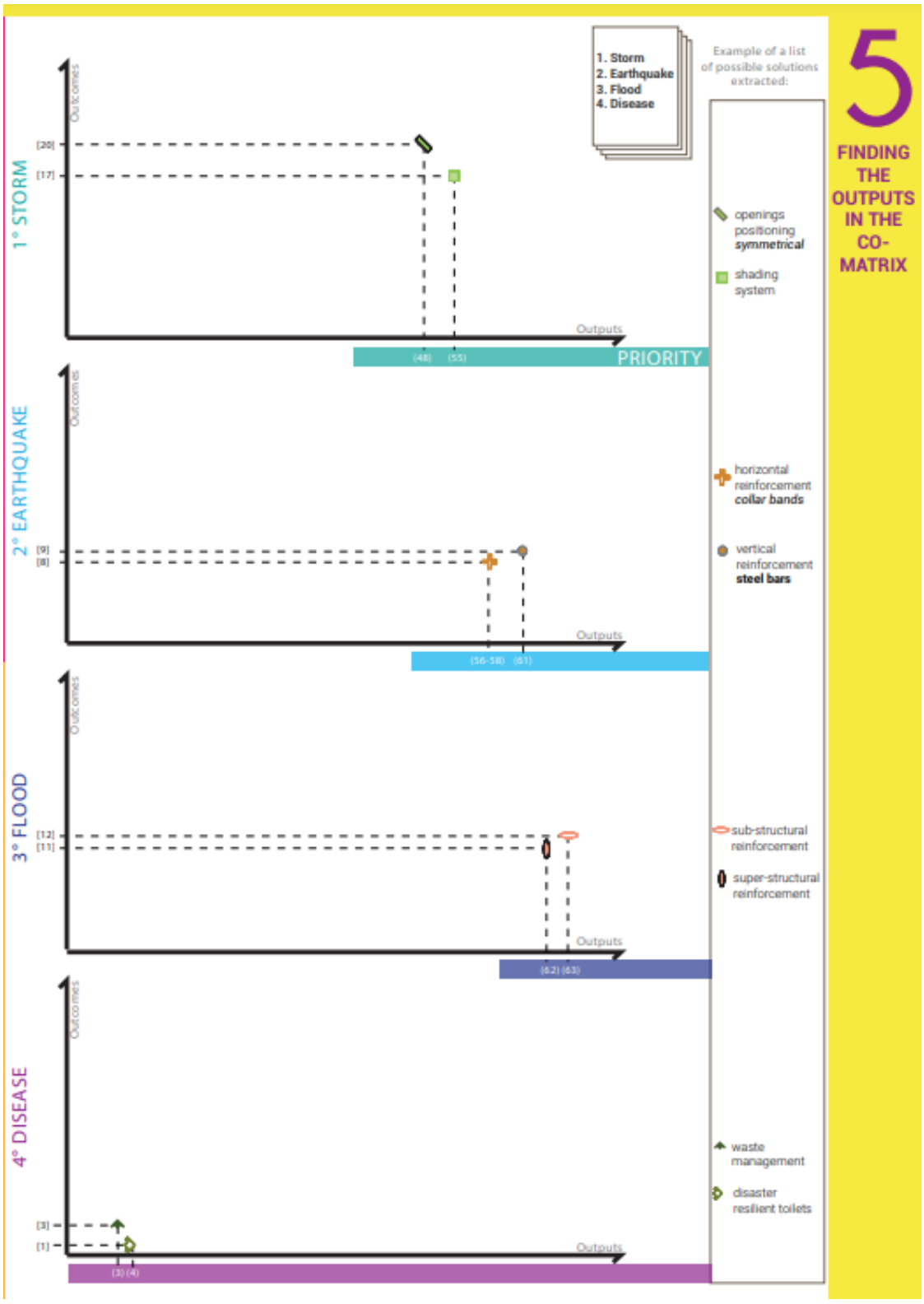
The INPUTS are defined for each hazard 2D matrix separately. They represent previously defined site characteristics of the area of application.
An example are these two inputs from each hazard matrix that further reveal eight outcomes:

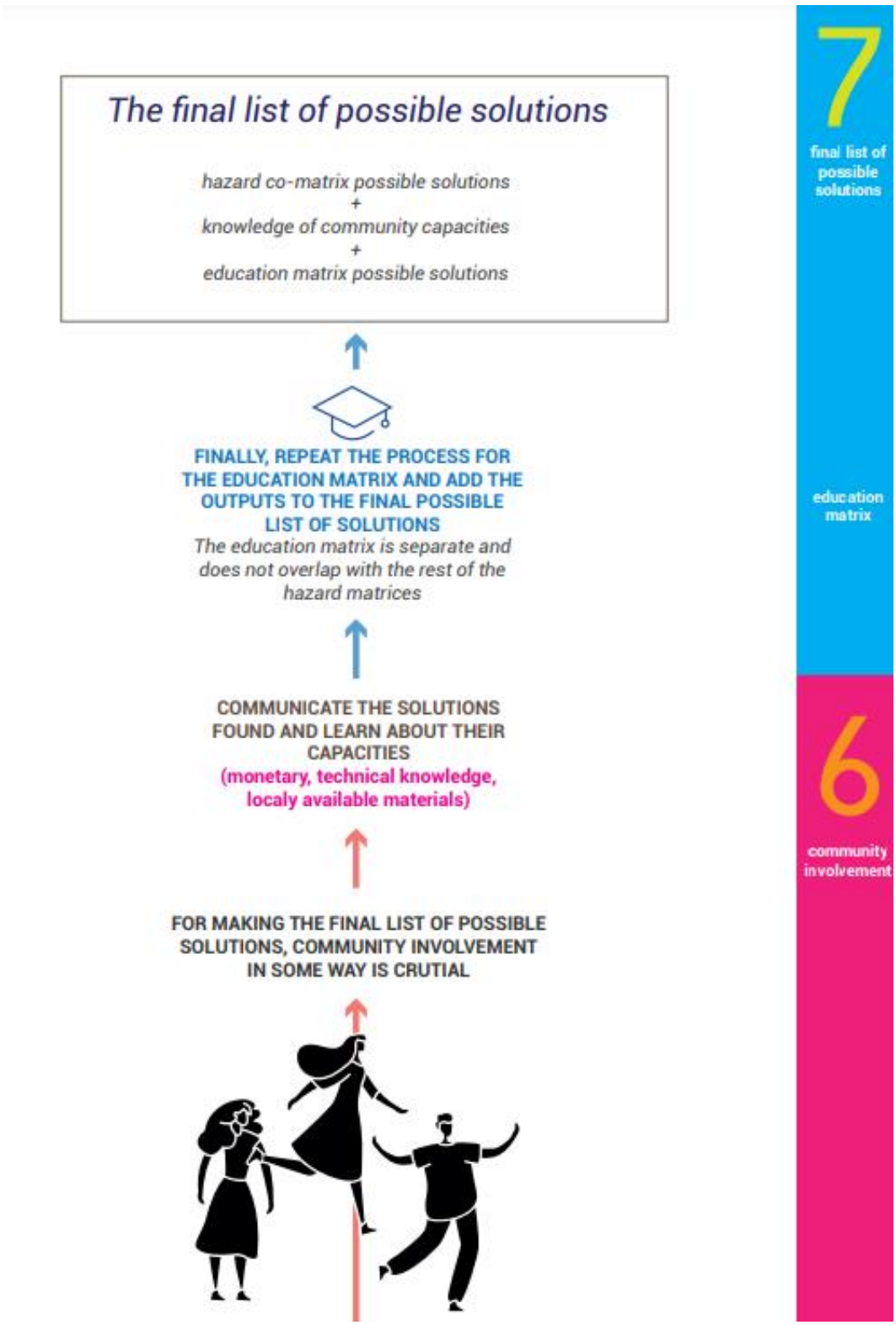
1. Storm matrix
2. Earthquake matrix
4. Flood matrix
4. Disease matrix



By following the line of each input, a corresponding outcome is revealed


The outputs axis is divided into 14 macro-groups with various architectonical features that can be adopted as possible solutions.
disaster resilient toilets
waste management
substructural reinforcement
superstructural reinforcement
horizontal reinforcement
vertical reinforcement
shading elements
positioning openings
1. Storm
2. Earthquake
3. Flood
4. Disease
vector borne diseases
water borne diseases
dry proofed building
wet proofed building
earthen building
stone building
minimize radiation
maximize ventilation
OUTPUTS ARE REPRESENTED THROUGH COLORS
OUTCOMES ARE REPRESENTED THROUGH SYMBOLS
Instead of looking at the outputs from each seperate matrix, we need to compare the multi-hazard outputs. To do that, we look at the combined over-lapped matrix for all four hazards, giving preference to the outputs coming from the highest ranked hazard
Outcomes
The outcomes axis is divided into 6 groups of needs or actions
Outputs
4
OUTPUTS
architectonic features
possible solutions
3
OUTCOMES
needs
actions


5
FINDING THE OUTPUTS IN THE CO-MATRIX
1. Storm
2. Earthquake
3. Flood
4. Disease
Example of a list of possible solutions extracted:
1° STORM
Outcomes
[20]
[17]
Outputs
(48) (55)
PRIORITY
openings positioning symmetrical
shading system
2° EARTHQUAKE
Outcomes
[9]
[8]
Outputs
(56-58) (61)
horizontal reinforcement collar bands
vertical reinforcement steel bars
3° FLOOD
Outcomes
[12]
[11]
Outputs
(62) (63)
sub-structural reinforcement
super-structural reinforcement
4° DISEASE
Outcomes
[3]
[1]
Outputs
(3) (4)
waste management
disaster resilient toilets



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