



***ELEMENTAL  
ALCHEMY***

*The continued development  
of Athens by the elemental  
forces*

**JAY MCALLISTER**

CALEDONIAN DREAMS  
MADE IN ATHENS

2021 - 2022

## ELEMENTAL

[Adjective]

Relating to, or resembling a great force of nature.

## ALCHEMY

[Noun]

The transmutation of matter.

### EARTH



### WATER



### FIRE



## ABSTRACT

*To what extent can the city be developed to allow citizen to live with nature?*

Flash flooding and wildfires are increasing drastically each year in Athens due to an ever-changing climate. In 2021 alone, thousands of citizens were displaced by flooding and fires, and about 100,874 acres of forest were destroyed. These climatic disasters shut off parts of the city, causing businesses to close and many to lose their lives and livelihoods. Athens is known for its ability to adapt and overcome, including rebuilding the city after major catastrophise including war, earthquakes, flooding, and fires, so why can't Athens overcome modern climatic disasters? To what extent can the city be developed to allow citizens to live with nature?

Throughout this investigatory text, the relationship that the people of Athens have with climatic disasters will be analysed alongside governmental responses to highlight failings from the past decade. This text will also look at national emergency response, while highlighting projects such as ORKA's Re-Think Athens, that offer an alternative cityscape that can reduce impact on climate change, while allowing citizens to live with these disasters.

Looking at both the historic and current relationship with the elements, while gathering materials from reading materials such as Fire and Memory - On Architecture and Energy by Luis Fernandez-Galiano, Towards emergency management of natural disasters and critical accidents: The Greek experience by Zoe Nivolianitou, and State of The Art: Greece by Theodore Stathopoulos, the research allowed for answering questions on the current guidance given by the Greek government on how to respond to an ever-changing climate.

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YORGOS BERDOS

WITH THANKS TO:  
UNIVERSITY OF DUNDEE  
LAURENCE WOOD  
RICHARD DUNDAS



JAY MCALLISTER

## **AUTHOR NOTE**

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It has been a pleasure to study under the guidance of my tutor, Yorgos Berdos, for the final year of my Master of Architecture course. I have had the freedom to explore and research a topic that is not only relevant to the world today, but greatly interests me and my passions in Architecture.

The following thesis is a culmination of a year of study and research on climatic conditions, in a city that was completely new to me. Understanding the issues of another climate and culture has lead me to be able to design a project that - if placed in reality - could help change how we interact with nature.

This text should be read in conjunction with other Elemental Alchemy materials produced, including final presentation boards, analytical studies, and group work.



**A STATUE OF GODDESS ATHENA IS SEEN AS WILDFIRE BURNS**

*SOURCE: Giorgos Moutafis/Reuters. Thick smoke over Athens as suburbs battle wildfires. Aljazeera. 2021.*

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ARTEMIS, PROTECTRESS OF THE LIVING WORLD, AS A HUNTRESS

SOURCE: Alinari/Art Resource, New York. Pallardy, Richard. "12 Greek Gods and Goddesses". Encyclopedia Britannica

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## INTRODUCTION

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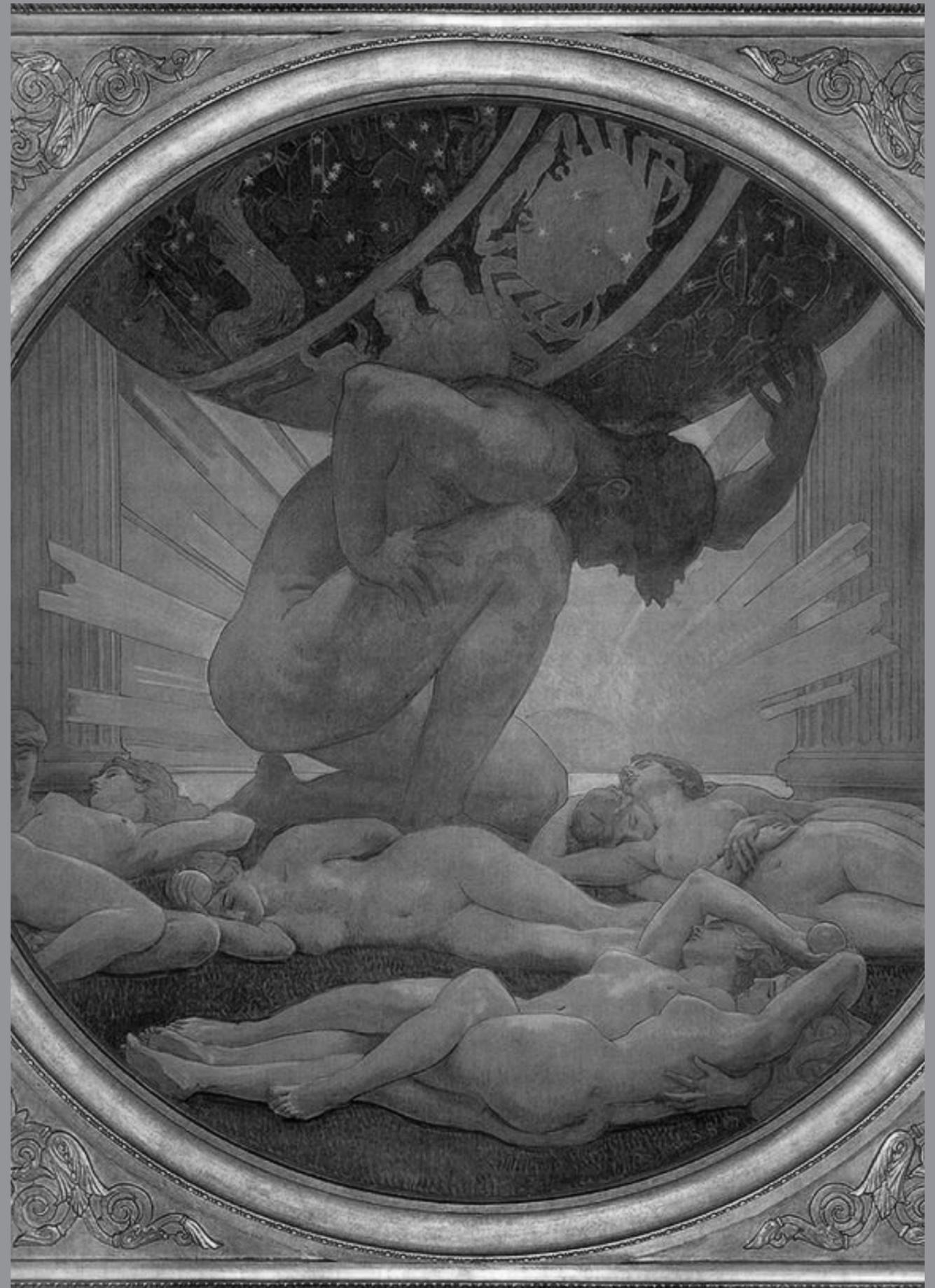
Greek mythology is rich with stories of Gods pulling mountains from the ground and defeating mythical creatures using elemental forces. These stories resonated with the Athenians for centuries, with elements being gifts from above. Earth, water, wind, and fire have shaped Athens to the city that it is today; retaining many of the hierarchies that were developed in ancient times. When we look back as to how the city has developed and how the city now reacts to natural disasters, we find ourselves asking the question: What would happen if we left Athens to embrace these disasters?

Through research of the development of the city of Athens, along with reading from texts such as *The Possibility For An Absolute Architecture* by Pier Vittorio, this thesis will dive into the environmental factors that shape the city – both historic and modern – while offering an argument towards leaving Athens to embrace natural disasters and how we can provide support for citizens during these times.

# 01

*Κίνηση της γης*

*MOVEMENT OF THE EARTH*



ATLAS AND THE HESPERIDES  
SOURCE: John Singer Sargent. Classical Wisdom.com. 2020.



ACROPOLIS SITTING ABOVE ATHENS

SOURCE: S.E.Barbour. Getty Images.

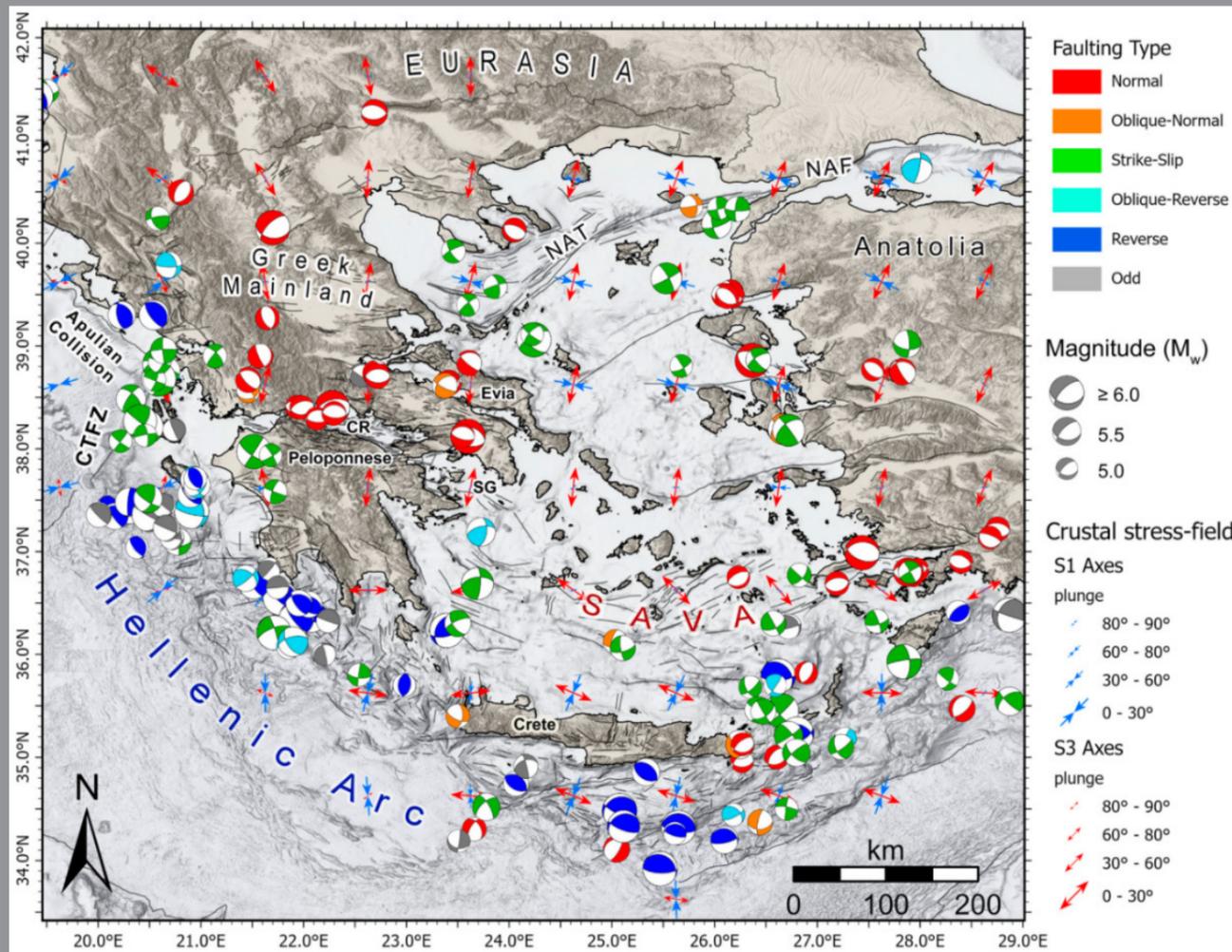
Geologically, Athens is in a mountainous valley, with the warm Mediterranean Sea to the South of the city. Greek historian Herodotus noted “In soft regions are born soft men”, which references the harsh mountains that form Greece, with the mountain ranges playing a major role in shaping the character of Athenians<sup>1</sup>. The earliest maps of Athens – dating back to approximately 630BCE – highlight the most important buildings of the period, all of which sit at the highest geographical location of the city.

The Acropolis sits in the centre of the city, atop a large hill looking down on the citizens below. The Pentelic marble of the Parthenon and the Erechtheion showcased the wealth of the city, with large standing columns that create the key characteristic of many ancient temples. Their positions reflect a battle ready city; sitting at the greatest advantage point from invading armies.

The hierarchy of the city meant that the affluent citizens were housed close to the centre, high above the impoverished that surrounded the Acropolis. The typical Athenian house was simple; small block houses often made from wood and mud bricks sometimes ranging over two floors, with a large kitchen, a storage room, an animal shed and lounge areas<sup>2</sup>.

These structures remain today, sat in ruins at the top of the hills. Still holding their position in the hierarchy of Athens, with them now being considered tourist attractions attracting around 3 million visitors each year (2.9 million visitors recorded in 2019, pre-pandemic)<sup>3</sup>.

1. F. Corcoran. Greece: Secrets of the Past. Canadian Museum of History. 2015.  
 2. P. Cartledge. The Greeks. Oxford University Press, U.S.A.; 2nd ed. Edition. 2002.  
 3. Acropolis in Athens Reopens After Virus Shutdown. Global Times. 2020.



MAP SHOWING THE MAIN SEISMOTECTONIC FEATURES OF THE GREEK TERRITORY  
 SOURCE: I.Kassaras, V.Kapetanidis, A.Ganas. The New Seismotectonic Atlas of Greece (v1.0) and Its Implementation. 2020.

Greece is regularly shaken by earthquakes, dating as far back as the 5th Century BC with reports of earthquakes associated with the graven of the North Euboia gulf. Notably, there was also a severe earthquake in September 1705, which caused considerable damage in and around the Acropolis<sup>4</sup>. These earthquakes prompted a change in building design, with focus on producing a strong base to support key buildings through seismic activity. Bases of Doric columns are typically much wider than the capital, being approximately 1.8m in diameter. This allows for more weight at the base and less at the top to avoid toppling during earthquakes. It is reasons like this that the Parthenon Ruins still stand today, having survived through a multitude of earthquakes in its 2,467 years.

In more modern times, Athens experienced a severe earthquake in September 1999, destroying more than 100 buildings with 143 people losing their lives. The seismotectonic setting of Athens is rather fascinating – the Athens plane lies in a piece of crust under extension, meaning it is constantly changing in size, on average around 10 to 20mm each year. The axis of the bounding active faults has a general East and West to West-North-West and East-South-East direction, similar to the topographic relief of the region, with pronounced features North-West of Athens (E.Lekkas, 2001). The epicentre of the shock was located around 20km North-West from the centre of Athens, with a magnitude of 5.9R.

4. E.Lekkas. The Athens Earthquake: Intensity Distribution and Controlling Factors. Engineering Geology, 59; Pages 297-311. 2001.



*ATHENIANS DIGGING THROUGH RUBBLE AFTER EARTHQUAKE*  
 SOURCE: Greek City Times. 1999.

Most of the damage from the earthquake could be located within a 10km radius of the epicentre, where state authorities conducted a vast categorisation of damaged buildings using a traffic light system. Green indicated that there was no visible damage affecting the structure of the building, yellow indicated minor damage to structural elements and significant damage to non-structural elements, and red indicated major damage to structural elements, so much so that the building should not be used until repaired. The data from the study showed that out of 217,940 inspected buildings – 3% (6519) were marked as red, 40.7% (88,784) were marked as yellow, and 56.3% (122,637) were marked as green<sup>5</sup>. All historical buildings of significance survived the earthquake undamaged.

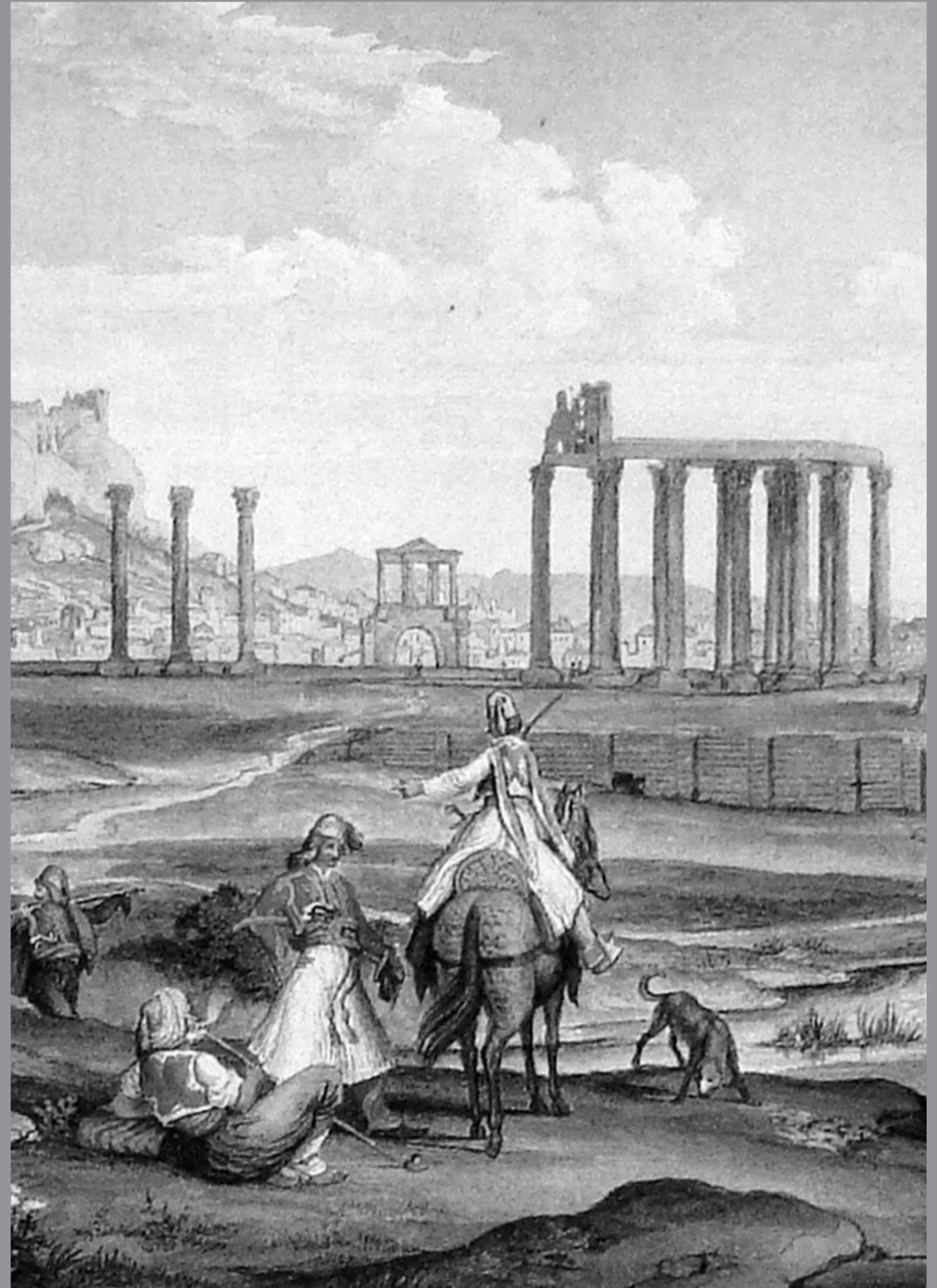
In response to the 1999 earthquake; the Greek government would introduce a form of legislation known as The National Earthquake Insurance, which would see public administration deal with the consequences after an earthquake occurs. This would mean ex post financing would be raised and subsidised loans would be made available to those effected, with outlays made available for repair of public buildings. This legislation was soon abandoned due to the lack of public finances and no margin for catastrophic losses<sup>6</sup>.

5. Lekkas, E., Kranis. EMS-1992 application on Kobe earthquake, Controlling factors of damage distribution. XXVI General Assembly of the European Seismological Commission (ESC). Tel Aviv. Pages 236+240. 1998.

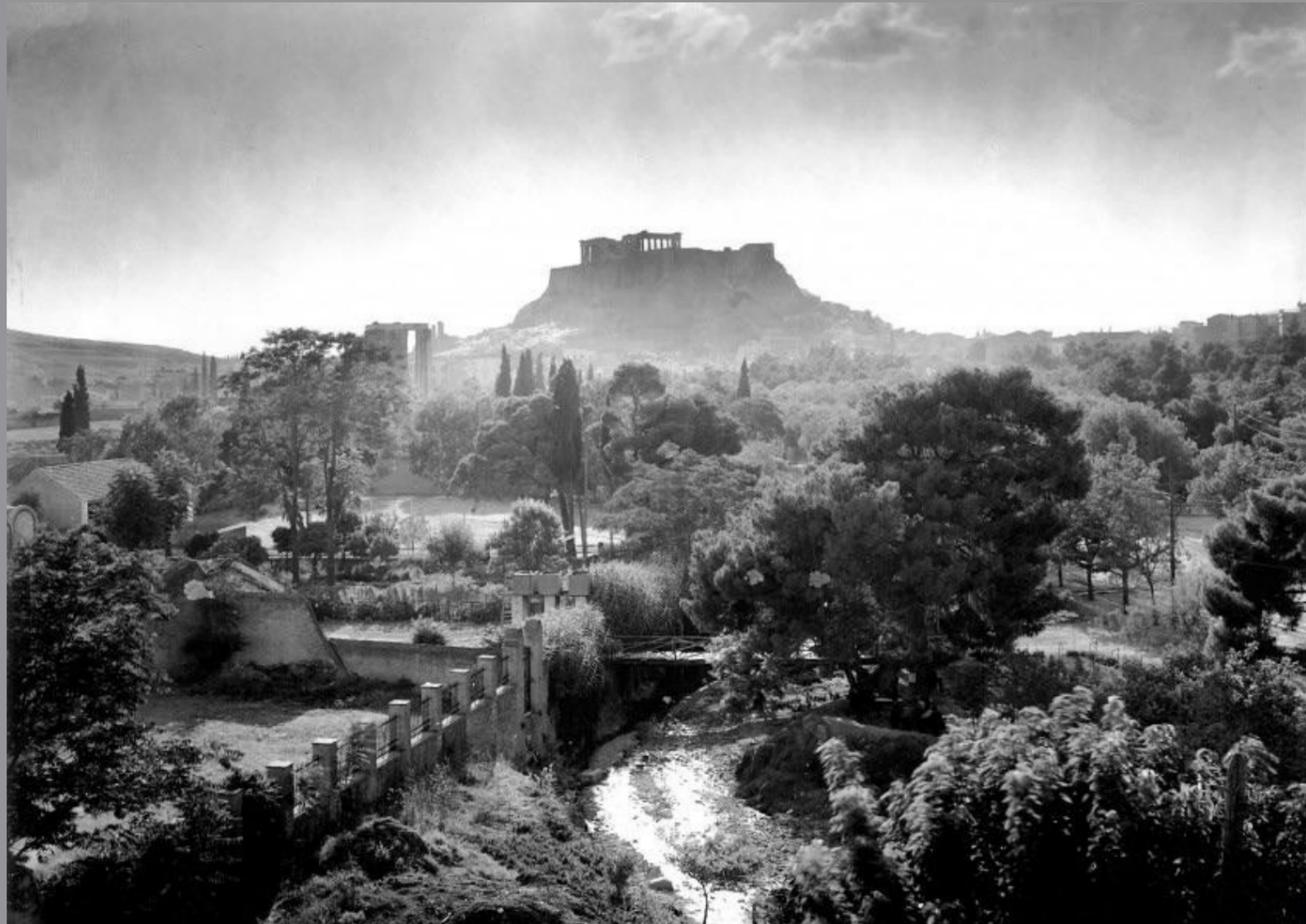
6. A.Petseti & M.Nektarios. Proposal for a National Earthquake Insurance Programme for Greece. The Geneva Papers. The International Association for the Study of Insurance Economics, 37. Pages 377–400. 2012.

*η ροή του νερού*

*THE FLOW OF WATER*



VIEW OF ATHENS FROM ILISSOS RIVER - PAINTING  
SOURCE: JOHANN MICHAEL WITTMER. 1833.



ATHENS ILISSOS RIVER, ST. FOTEINI  
SOURCE: *The Athens Key*. 1910.

Long before the Athens that stands today, was a very different city. A city that lived and flourished from the land carved by nature. From the mountains North of Athens, runs the river Kifissos, flowing down through the western part of the city down into the Saronic Gulf. The river Ilissos also originates from the mountains, flowing this time through the heart of the city to join the river Eridonos, which springs from the base of Lybacettus Hill<sup>7</sup>. These rivers fed not only the land but the Athenians who require fresh water to live and grow food.

Ilissos springs from the North-Western slopes of the Hymettus Mountains, running outside the Eastern and Southern walls of the Ancient city. The river moves West, collecting drained rainwater from its seasonal streams that converge along its path. Branches of Ilissos flow through the Kaisariane Monastery and the Byzantine Monastery of St John the Theologian, South of Cholargos, where several aqueducts were built parallel to the river to feed fields further away. Heading South, passing the Panathenaic Stadium to the Byzantine chapel of St Foteini of Ilissos, there is a shallow marsh known to locals as Vatrachonisi or “Frog Island”, where many plants and wildlife flourish. Ilissos then moves South-Eastern past the Roman Temple of Zeus towards Faliron before converging with the river Eridonos, heading towards the Saronic Gulf, near Port Piraeus<sup>8</sup>.

7.M.Welch. How To Explore The Lost Ancient Rivers of Athens. DefinitelyGreece.com. 2019.

8. A.Pappa. Ilissos and Kifissos Rivers-Greece. Influence of human factors on basins' evolution. A sociohydrological point of view. Delft University of Technology. 2021.



NEW ATHENS PLAN

SOURCE: Gustav Eduard Schaubert. 1812.

During the 19th Century, it was decided by the Greek Government that Ilissos should be covered, directing the flow of the river underground. This was due to two key factors; an increasing population meant that land to build on was scarce, and the use of the river's banks for building materials meant that the quality of both the water and the river's banks had decreased dramatically. The river was used primarily for sewage and waste, causing heavy pollution and ingestion would cause diseases like cholera.

In 1812, the Greek Independence War began to secure Greece from Ottoman rule. As a result in 1830, Greece became an independent country and began planning a new capital city. At this time, Athens had a population of 12,000 in need of a development that would best utilize the land and build new infrastructure networks. Urban planners Gustav Eduard Schaubert and Stamatios Kleanthis designed the first plan for the new city. This would see development towards the North, creating a long vista between the Acropolis and the Church of Panaghia Kapnikarea, East, creating a link to the Panathenatic Stadium, and West, the road towards Piraeus – forming the iconic triangle of the centre of Athens<sup>9</sup>. It was during this time that sand from the embankments of the river Ilissos was used to build the new fabric of the city, which in turn caused major flooding to the surrounding areas. With the price of land and the population increasing, the decision was made to cover the river to make way for new buildings.

9. A. Balducci &amp; D. Monioudi-Gavala. The evolution of Athens as a capital city: the early plans. University Of Patras. 2019.



### FLASH FLOODING IN ATHENS

SOURCE: Xinhua / Barcroft Images. Deadly flash floods cause 'biblical damage' in Athens. The Guardian. 2017.

In modern times, covering the river has become more of a burden on the city. Athens experiences hot dry summers, but inversely experiences mild wet winters with average precipitation ranging from 5mm to 65mm each month in 2020<sup>10</sup>, with flash flooding occurring around twice a year. This can be attributed to a high-water table due to covered rivers and the banks of the river never being maintained after excavation for materials and minerals.

Most notably, in November 2017, flash floods on the outskirts of Athens caused "biblical damage", killing 15 people, and injuring many more. The towns of Mandra, Nea Peramos and Megara were mainly affected, all located West of the city. The heavy downpour turned roads into rivers of mud and debris, trapping many in their cars while being washed away. A section of highway that connected Athens to Corinth had caved in, while many were left without power due to downed power lines. Firefighters registered around 340 calls for help, most to pump water from flooded homes and businesses. Around 1,000 people were affected by the flooding<sup>11</sup>.

Many experts speculated that illegal construction over springs and riverbeds increased the flooding in the area, meaning the water had no natural outlet to the sea. Dimitris Papanikolaou, emeritus professor of geology at Athens University stated, "Nature had already warned that such intervention was disastrous, that not maintaining the natural flow of water was disastrous."<sup>12</sup>

10. Climates To Travel - Athens Greece.2020.

11. H.Smith. Deadly flash floods cause 'biblical damage' in Athens. The Guardian. 2017.

12. H.Smith. Illegal building 'played central role' in floods that killed 20 in Athens. The Guardian. 2017.

*τυλιγμένο από φωτιά*

*ENGULFED BY FIRE*



*FIRES ARE RAGING ON EVIA*

*SOURCE: Angelos Tzartinis/AFP/Getty Images. Greece Wildfires. The Independent. 2021.*



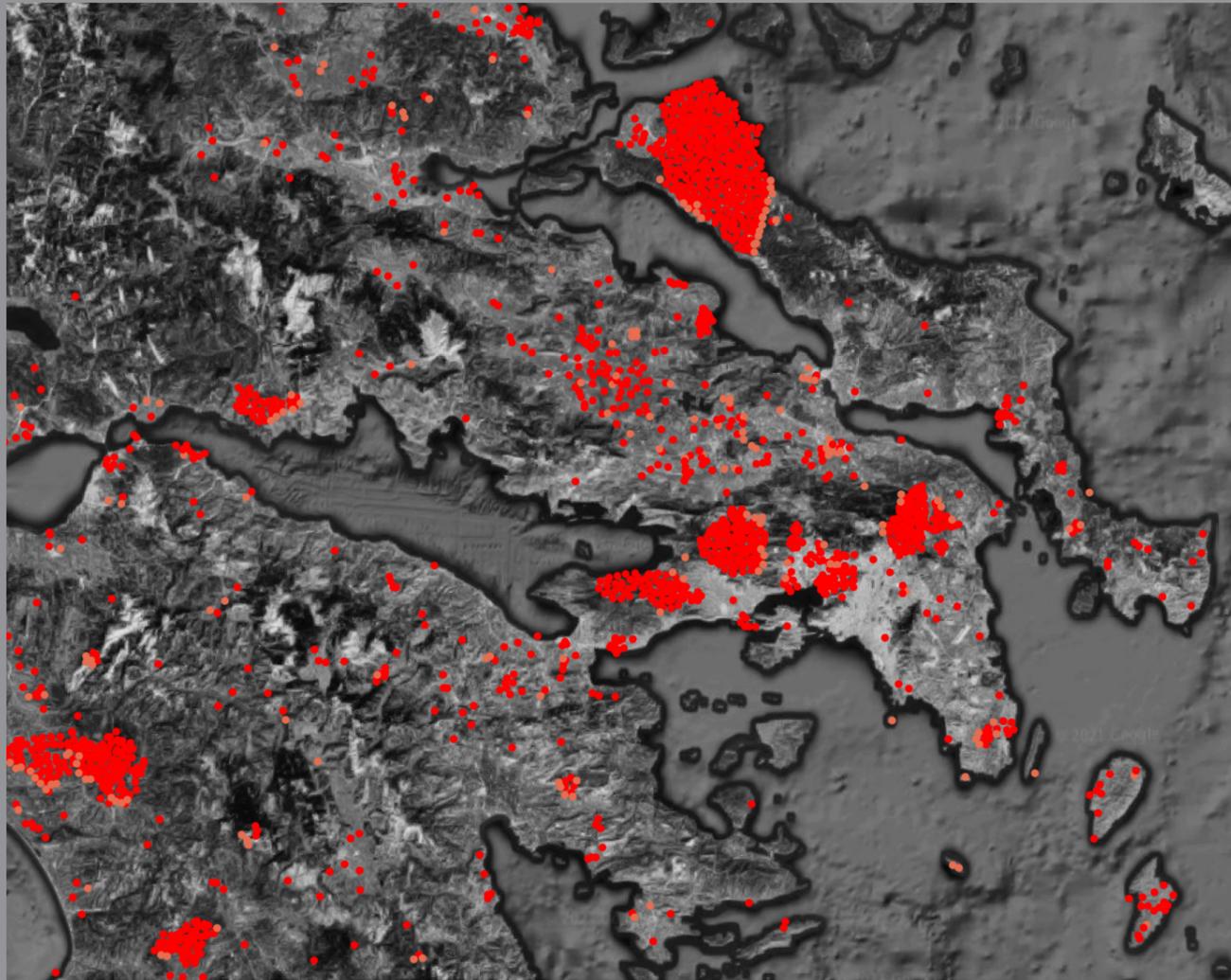
STATUE OF DEITY WITH PEPLUM, KNOWN AS HESTIA GIUSTINIANI  
SOURCE: Giustiniani Collection. Fondazione Torlonia. 2022.

As buildings developed from caves to primal huts, fire was always a prominent feature of the survival of dwellers. The hearth allowed dwellers to cook raw meats, provide warmth through colder nights, and was even used to craft tools for the advancement of civilisation.

In the centre of Athens, a communal hearth would burn, considered the heart of the city, inviting citizens to gather for heat and to cook food together. Everyone was welcomed by the warm heat. The hearth then moved into the homes and shelters, providing a life source for many. Fire was always welcome in Athens. In Greek Mythology, Hephaestus the God of Fire, was said to craft weapons for the Gods in natural volcano eruptions and wildfires. Handing his skills down to the citizens of Athens<sup>13</sup>.

Hestia, Goddess of the Hearth, was said to have burned her fire in the Prytaneion – a town hall of the Greek State, a communal place for ambassadors, distinguished foreigners, and citizens. This was an internal centre of the city, known as the “home where you start from”. This implies that the hearth was a space for citizens, both new and old, to gather and seek wisdom from those in higher positions. It was a place for entertainment, discussion, and meeting<sup>14</sup>.

13. G.Fernández. L.Fernández-Galiano. Fire and Memory - On Architecture and Energy. MIT Press. 2000.  
14. Britannica, T. Editors of Encyclopaedia. “prytaneum.” Encyclopedia Britannica. 2014.



MAP OF FIRE LOCATIONS ACROSS GREECE  
SOURCE: J.McAllister. 2021.

Current day citizens have a very different relationship with fire. Instead of embracing its warmth and comfort, wildfires are destroying vast areas of land each year. Instead of being brought together, they are being forced apart, and even away from Athens as wildfires engulf homes and livelihoods.

Due to many factors, both environmental and man-made, Greece experiences an exponentially large number of wildfires each year. Global warming has seen the summer temperatures rise around 1.5o C since the 1980s, with average temperatures of 29oC in July each year<sup>15</sup>. These hot months dry out the land and make vegetation prone to ignition, coupled with concrete construction and infrastructure, there is very little stopping a fire from spreading quickly across large areas of land.

The Summer of 2018 saw the deadliest wildfire of the century, at the seaside town of Mati located roughly 34km East of the Municipality of Athens. The fire began in a heavily wooded area, by a 65-year-old man allegedly burning brushwood outside his home, and quickly spread to the neighbouring properties and woodland areas. Within hours, the fire had become out of control and was headed for the bustling seaside resorts, where hundreds of tourists and locals were on the beaches unaware of the tragedy about to unfold.

15. K.T. Papakostas, P. Zagana-Papavasileiou, T. Mavromatis. Analysis Of 3 Decades Temperature Data For Athens And Thessaloniki, Greece - Impact Of Temperature Changes On Energy Consumption For Heating And Cooling Of Buildings. University of Thessaloniki. 2013.



TITLE  
SOURCE:

By 8pm, the town was engulfed in flames and Mati was destroyed. The roads were blocked by panicked drivers attempting to flee, many of which died in their cars. Thousands fled into the sea to seek protection from the flames, not knowing that it would be hours before coastguards and local fishermen would rescue them. The rapid spreading blaze was driven by gale-force winds and the dry surrounding pine trees<sup>16</sup>. Witnesses to the event tell stories of naked female neighbours whose clothes were burned off, bodies scattering the streets, and even swimming with smoke filled bodies as they awaited their rescue.

In the days after the fire, it was confirmed that 103 people were killed in the fire, some found in embrace within their homes with no way out. Over 5,600 hectares of land burned, destroying thousands of buildings, and leaving many suffering injuries. The government funded clean-up operation saw delays to authorisation of licenses for repair the roughly 3,000 houses destroyed, meaning that residents were left homeless for months. Prime Minister at the time, Alexis Tsipras, blamed unlicensed building of a settlement for the mass casualties. This was resonated by Maria Kleanthis, head of the Department of Natural Disasters at The Ministry Of Infrastructure, who told press that people had built on unauthorised areas including the waterfront, forests and ravines, which would have increased the spread of the fire significantly due to lack of fire breaks<sup>17</sup>.

16. D.Sideridis. 'Swimming with dead bodies': A year on, Greeks haunted by inferno. Aljazeera. 2019.

17. H.Smith. 'In my nightmares I'm always in the sea': a year on from the Greek fires. The Guardian. 2019.



**FIREFIGHTER FIGHTING BLAZES IN MATI**

SOURCE: Reuters. *Blaze Sweeps Through Athens Suburbs*. CNN. 2021.



**WOMAN REACTS TO FIRE DAMAGE**

SOURCE: Getty Images. *Trapped Between Fire and Sea*. The Independent. 2018.

In response, many residents filed a lawsuit against the government for their lack of response and resources following the fire. There were no warning sirens, and fire-fighting volunteers were sparse as they were fighting other wildfires away from the area. Residents complained about the unauthorised buildings that regularly litter Greece, which is not common in any other EU country, which are regularly linked to climatic disasters. Many media outlets believe that the delayed response from the government contributed greatly to Alexis Tsipras's defeat in the following general election.

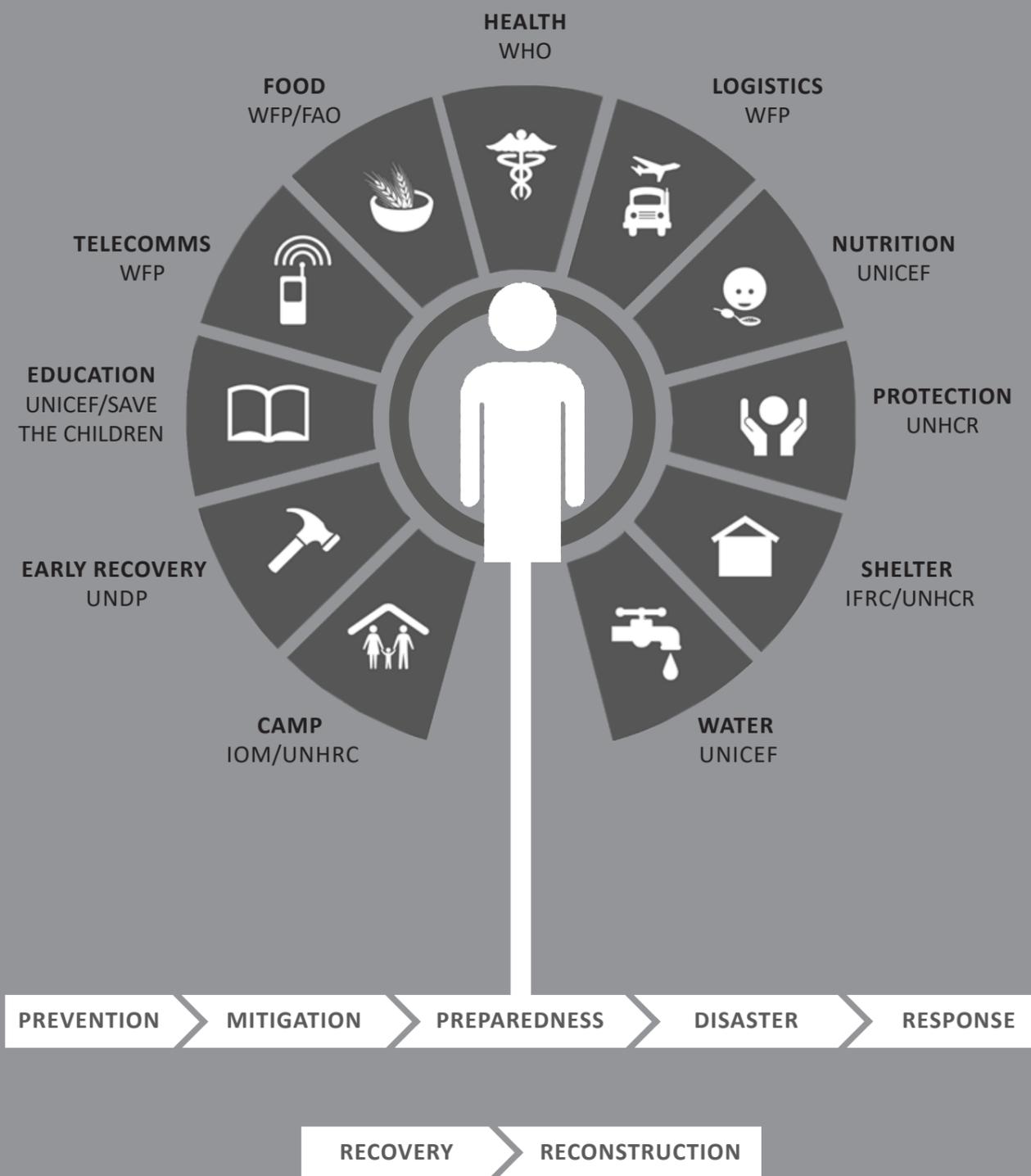
In 2021, Athens still experiences devastating wildfires. Most notably in June, when a small wildfire began burning over the northern half of Evia, an island around 30 miles northeast of Athens. 120,000 acres of burned forest, hundreds of millions of euros in economic loss, and the wholesale evacuation of dozens of villages and thousands of islanders. Two people were killed. Also in August, when a wildfire on the outskirts of Athens that destroyed or seriously damaged dozens of homes overnight, forced thousands to flee, and threatened a former royal palace, 20 kilometres north of the Greek capital. More than 100 homes and businesses had been seriously damaged or destroyed, and over 500 people had spent the night in shelters. More than 580 fires were observed throughout the country since July 27, razing hundreds of houses, and businesses to the ground. 100,874 hectares of forest and olive groves scorched and three people were killed.

*Αμεση δράση*

*EMERGENCY RESPONSE*



CORTEX SHELTER BY CUTWORK  
SOURCE: DEZEEN. I.BLOCK. 2019.

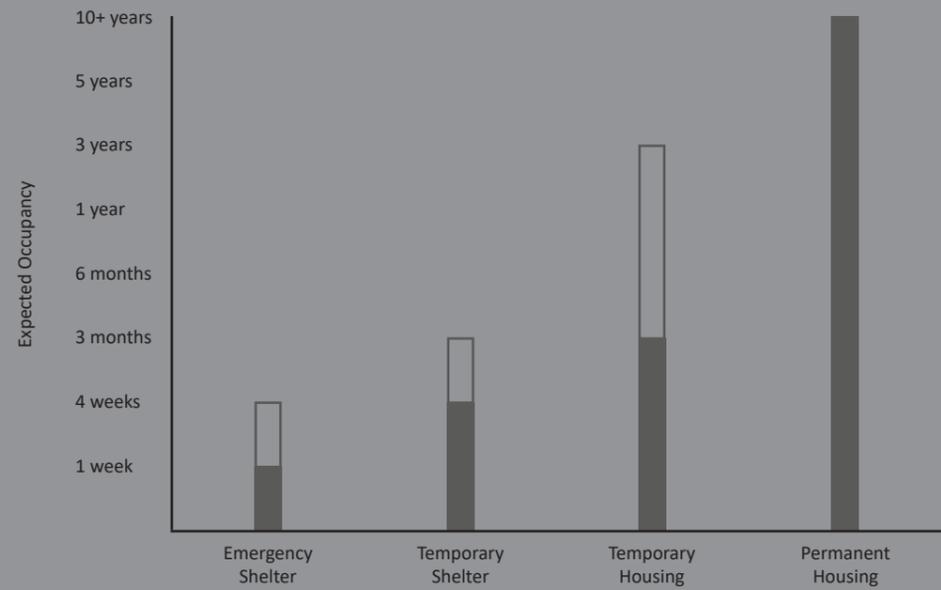


UN IASC CLUSTER APPROACH  
 SOURCE: Humanitarian Response. What is the Cluster Approach? 2020.

According to UN/ISDR(2004) terminology, a disaster is defined as “a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources, so external aids are needed.”

When it comes to elemental disasters in Athens, the General Secretariat for Civil Protection (GSCP) is responsible for the prevention, management, and monitoring of natural disasters. The GSCP is part of the Ministry for Climate Crisis and Civil Protection, who according to Presidential Decree 151/2004, aim to study, prevent, organise, and coordinate action for the prevention and response to natural, technological, and other disasters or emergencies. As part of their protection of the public, the GSCP issue Self-Protection Guidelines, including information about earthquakes, landslides, forest fires, floods and more. Even though the GSCP is the state governed body that holds the responsibilities for emergency disasters, the organisation does not play a substantial role when it comes to on-site abatement of a crisis<sup>18</sup>. Rather, in the state of a climatic emergency, several voluntary and specialised organisations will be the first point of contact for those effected by disaster.

18. Z.Nivolianitou, B.Synodinou. Towards emergency management of natural disasters and critical accidents: The Greek experience. Journal of Environmental Management. Volume 92, Issue 10. 2011. Pages 2657-2665.



**EXPECTED OCCUPANCY OF STAGES OF EMERGENCY SHELTER**

DATA: D Félix, J.M. Branco, A Feio. Temporary housing after disasters: A state of the art survey. Habitat International. Volume 40. 2013.

<i>Emergency Shelter</i>	<i>A place where survivors stay for a short period of time during the height of the emergency, which can be in the house of a friend or a public shelter.</i>
<i>Temporary Shelter</i>	<i>Used for an expected short stay, ideally no more than a few weeks after the disaster. This may be a tent, a public mass shelter, etc.</i>
<i>Temporary Housing</i>	<i>The place where survivors can reside temporarily, usually planned for six months to three years, returning to their normal daily activities, and can take the form of a prefabricated house, a rented house, etc.</i>
<i>Permanent Housing</i>	<i>Return to the rebuilt house or resettle in a new one to live permanently.</i>

**DEFINITIONS OF STAGES OF EMERGENCY SHELTER**

DATA: D Félix, J.M. Branco, A Feio. Temporary housing after disasters: A state of the art survey. Habitat International. Volume 40. 2013.

Most volunteers that immediately respond to disasters are locals, many of which volunteer for fire rescue services all year round. The majority of these first responders are not adequately trained or paid for their efforts. The Hellenic Fire Service is the national agency for fire and rescue in Greece, which contributes to the Fire Brigade efforts during natural and man-made disasters<sup>19</sup>.

Voluntary organisations such as the Red Cross, Oxfam and the United Nations are some of the first people to respond to a climatic disaster, providing rescue efforts and temporary shelters for those displaced. These shelters typically are tents, much too small and not appropriate for long term use. According to Oxfam, a standard emergency shelter tent can sleep up to eight people in temperate or tropical climates, provided there is adequate site selection, drainage, and access to clean water and sanitation<sup>20</sup>. Therefore, these tents are not suitable in situations where the ground is not level, there is no drainage, or the water supply is affected by the disaster. These tents are defined by the United Nations Disaster Relief Ordinator (UNDRO) as temporary shelters – “used for an expected short stay, ideally no more than a few weeks after the disaster”<sup>21</sup>.

19. Hellenic fire Service. Fireservice.gr. 2022.

20. Oxfam Supply Centre. Tent, Family shelter. Supplycentre.oxfam.org.uk. 2022.

21. D Félix, J.M. Branco, A Feio. Temporary housing after disasters: A state of the art survey. Habitat International. Volume 40. 2013. Pages 136-141.



UNHCR EMERGENCY SHELTER TENT

SOURCE: Centre for Civilians In Conflict. Operation Inherent Resolve. 2017.



IKEA TEMPORARY HOUSING

SOURCE: Better shelter. Why Ikea's Flatpack Refugee Shelter Won Design of the Year. The Guardian. 2017.

The next form of emergency housing is considered temporary housing, defined by UNDRO as “the place where survivors can reside temporarily, usually planned for six months to three years, returning to their normal daily activities. And can take the form of a prefabricated house, rented house, etc.” Traditional temporary housing can take the form of metal prefabricated boxes, which can be inadequate for local conditions and resources. In most forms, temporary housing has two key sustainability problems; one being that they are not cost efficient, and the other being they are environmentally unsustainable.

In terms of cost, according to UNDRO (1982) temporary housing can cost up to three times more than a permanent house per unit. This is not including the cost of infrastructure required such as roads, electricity, sewerage, and water supply, which are basic human needs in the modern world. UNDRO (1982) states that temporary housing “is an expensive object which is not affordable for developing countries”<sup>22</sup>. Because of the high upstart costs, many experts have argued that temporary housing is not required as it can cause delays in the reconstruction of permanent housing, overspending of resources, and residents overstaying in shelters which are not fit for permanent living. This can lead to social issues such as stigma around those residing in the units.

22. F. Hadafi, A. Fallahi. Temporary Housing Respond to Disasters in Developing Countries- Case Study: Iran Ardabil and Lorestan Province Earthquakes. World Academy of Science, Engineering and Technology International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering. Volume 4. 2010.

**FEATURES & MATERIALS**

**ROOF AND WALLS**  
Made of lightweight semi-hard plastic designed to last at least three years – compared to six months for conventional refugee tent

**SHADE-NET**  
Metallic fabric deflects heat during day and retains it at night

**SOLAR PANEL**  
Powers built-in lamp and USB port

**Lamp**

**Curtains**

**Windows**

**Plastic sheet flooring**

**METAL FRAME**  
Held together by connectors & wires

**Roof and wall panels snap onto metal frame and secured by plastic fasteners**

**MEASUREMENTS**

**SIZE**  
188 square feet

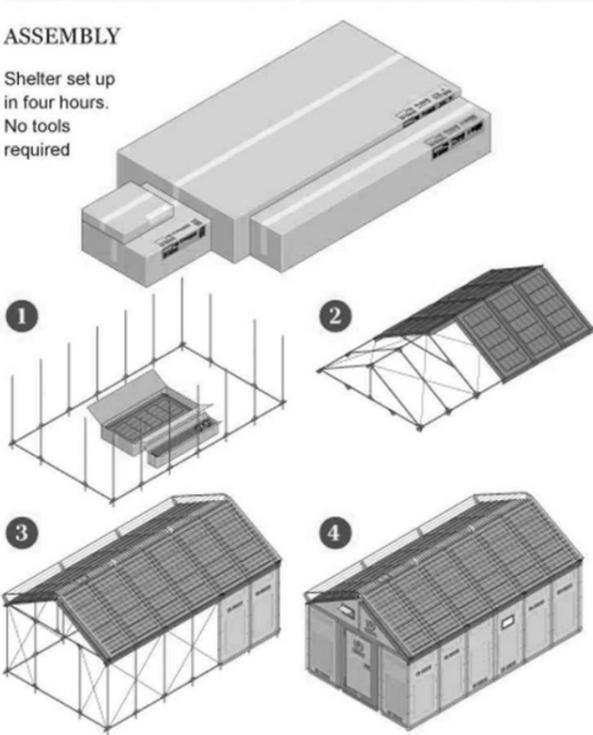
**WEIGHT**  
100kg

**HOUSES**  
Five people 

**COST**  
£638 per unit once in mass production

**ASSEMBLY**

Shelter set up in four hours.  
No tools required



Environmentally speaking, these units are generally shipped to the location of the emergency, which in turn means they are not always suited to the climate of the country. For example, metal temporary housing structures are not suitable for very warm climates as they contain the heat making it almost unbearable to live in. This can also be the same for colder climates, especially during the night as the shelters do not retain heat. Ventilation can be a key issue also, as many of the shelters do not have large openable windows. By making temporary housing more comfortable, the shelters become more durable than their short-term expectancy. Meaning the units can still be used long after their intended lifespan, usually leading to large amounts of structures with nowhere to store them. This leads to deconstruction without concern for re-purpose of the materials.



ALL HANDS AND HEARTS VOLUNTEERS  
SOURCE: ALL HANDS AND HEARTS FOUNDATION, 2020.

Organisations, such as All Hands and Hearts, are involved in disaster relief by constructing temporary housing with a difference in strategy. All Hands works with locals to build sustainable housing units that are fit for purpose, using local materials and knowledge to build units that will withstand further climatic conditions with only minor repairs needing to take place.

“All Hands and Hearts effectively and efficiently addresses the immediate and long-term needs of communities impacted by natural disasters. We communicate directly with local leaders and community members and then deploy our unique model of engaging volunteers to enable direct impact, helping to build safer, more resilient schools, homes, and infrastructure.<sup>23</sup>”

Unlike traditional temporary housing solutions, All Hands promote a key sustainability strategy which aligns with the UN Sustainability Development Goals (SDGs), focusing on an accelerated progress towards quality education, clean water and sanitation, and sustainable cities and communities. These goals help towards building a stronger community with buildings and infrastructures built to withstand the elements, providing permanent temporary housing solutions which can be used in future elemental disasters, as well as providing improved facilities to the community.

23. All Hands and Hearts Organisation. Mission Statement. Allhandsandhearts.org. 2022.

*ΣΥΝΕΝΤΕΥΞΗ*

*LAURENCE WOOD INTERVIEW*



*SAN ISIDRO TEMPORARY HOUSING, PHILIPPINES  
SOURCE: LAURENCE WOOD. 2022.*



LAURENCE WOOD WORKING WITH TEAM IN PHILIPPINES  
SOURCE: LAURENCE WOOD. 2022.

Laurence Wood, a current tutor at the University of Dundee and former architectural designer for All Hands, has first-hand knowledge of working in disaster zones, with displaced people needing homes fit for purpose.

The full interview can be found in Appendix.

The following answers provide insight into constructing better shelters in disaster prone areas.

***What are the benefits of constructing semi-permanent housing over temporary housing such as the Ikea Temporary House?***

I think my response to this question of why semi-permanent Housing/ Shelter has benefits is due to the 'slow architecture', that is being given the time to develop, not just a house design, but what are all the problems and opportunities in responding. We don't always have that time to react efficiently or with the whole picture.

Our semi-permanent shelter design was taken from vernacular housing types, however, we redesigned the;

1. Construction process for ease of construction by unskilled work force,
2. Designed the super-structure extremely strongly, using bracing, so if a storm hit the main structure would still stand.
3. Use local materials, to keep cultural recognition and support local business
4. Use sacrificial materials, if damage happens materials can be upgraded or replaced cost effectively.
5. Create a community by talking and discussing decisions.
6. Creating an entrepreneurial hub using micro financing to aid livelihood and opportunity.

This is much more difficult when housing plans are handed out with little support.



TEMPORARY HOUSING, PHILIPPINES  
SOURCE: LAURENCE WOOD, 2022.

***What is the difference when designing for environmental disasters compared to designing Western traditional housing?***

‘Know your client, know your context’, I don’t know if that’s been said before, but I keep that for any design.

I find it difficult to explain that the term ‘design’ is different, my outlook being in disaster areas is solving problems, but doing this with the foresight of future problems and that the problem might also hold an opportunity. I have had great experience in using slightly adapting traditional housing types in shelter projects, I think in the places I have worked we have a responsibility in having a cultural reference, I would be disappointed if we reacted to all projects in the same way and lose culture and history due to convenience.

Building following environmental disasters compared to out of a traditional practice is very different.

***Are there specifics when it comes to constructing in disaster zones that people don't realise in comparison to traditional construction?***

Families- You are working for affected/ vulnerable people who may be going through trauma and having to look after other family members, there is a race to get them into safe accommodation as quickly as possible.

- Materials- We seen this problem recently in the UK with the building boom and international delivery, at a time when thousands of people want to rebuild and the governments are buying significant amounts of materials, it can be very difficult to get materials, this may have to be built into the design process for availability.
- Workforce- It may be difficult to get qualified or experienced workers.
- Media- After being interviewed by international media from Al Jazeera to CNN, the world may be watching...

***Regarding the design of your temporary housing, how will it react to future environmental disasters such as earthquakes, extreme temperatures, and flash flooding?***

As mentioned, we used a traditional vernacular housing type that inherently through its design deals with extreme heat and flooding. Seismically, the shelters we built use coco lumber a material similar to timber. We used traditional jointing and secured with nails, this would allow for some movement in earthquakes, this may be more suitable than the core houses being built with low grade cement block.



TRAINING, PHILIPPINES  
SOURCE: LAURENCE WOOD. 2022.

***What training systems did you put in place for local workers, and how will that benefit the locals after constructing these emergency shelters?***

Training was initially seen as it was not needed. I had seen so many good well intentioned INGO's provide funding and material to projects and hired workers to get the job done. That is great and required, however, we viewed the training as a way to motivate our workers, at some points we had over 400 workers on one project all managed and all monitored for skill levels, there were many benefits to training with visual aids.

Efficient teams- We divided the shelter into 12 parts, (Foundations, Superstructure, roofing, cladding etc...) then asked our small team what they preferred they did based on experience. 12 very experienced workers stepped forward and identified their team. We now have 12 teams appointed to 12 parts. We then timed how long it took to do finish their part. We now have a timeline which helped us plan the project. We found each team got more efficient over a week or so and we could stage by stage complete each shelter. 12 days to complete 1, but then each day after another would be completed.

- Safety- Each team leader looked after their team and in return were given a higher pay.
- Apprenticeship- more experienced workers passed on knowledge and skills using our visual aids translated into local language. These workers then trained their team for bigger projects
- Capacity building- We taught best practice so workers could help other family members rebuild.
- Incentives- We had worked out that 36 homes a week was our goal, if we hit that target there would be a paid day off, we had a few of them in each project.
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TEMPORARY HOUSE CONSTRUCTION, PHILIPPINES  
SOURCE: LAURENCE WOOD, 2022.

***Your training has been acknowledged by world recognised foundations, what impact has that had on more recent and future climatic disasters?***

The International Labor Organisation invested in our training and was presented on national TV in the Philippines, further to this we don't quite know if training is being implemented in other disaster rebuild programs...

I think mitigating disaster through education and practice is vital and I push for this in many other projects.

***You are an advocate for "no natural disasters" - what does that mean for the future of natural disasters and climate change?***

Collectively we have been sold into using the term 'natural disaster', this term usually followed by the deaths associated or the damage to infrastructure depicting how big of a disaster it is.

All the no natural disaster 'movement' is suggesting is that in order to prevent loss of life and interruption to infrastructure is to build this in to considerations going forward. In the Philippines, it is part of life to be affected by typhoons, the incident happens over a few hours, the rebuild programs can take years, these storms may be decreasing in frequency but are becoming more impactful as we deal with rising population and density in housing, it is not just the storm but the decision making before during and after.

## Υπάρχουσα καθοδήγηση

EXISTING GUIDANCE



TYPICAL POLYKATOIKIAS FROM THE "ATHENS ARCHIVE."  
SOURCE: CHARALAMBOS LOUIZIDIS AND AIKATERINI NIKI GLINOY. MAS CONTEXT. 2014.

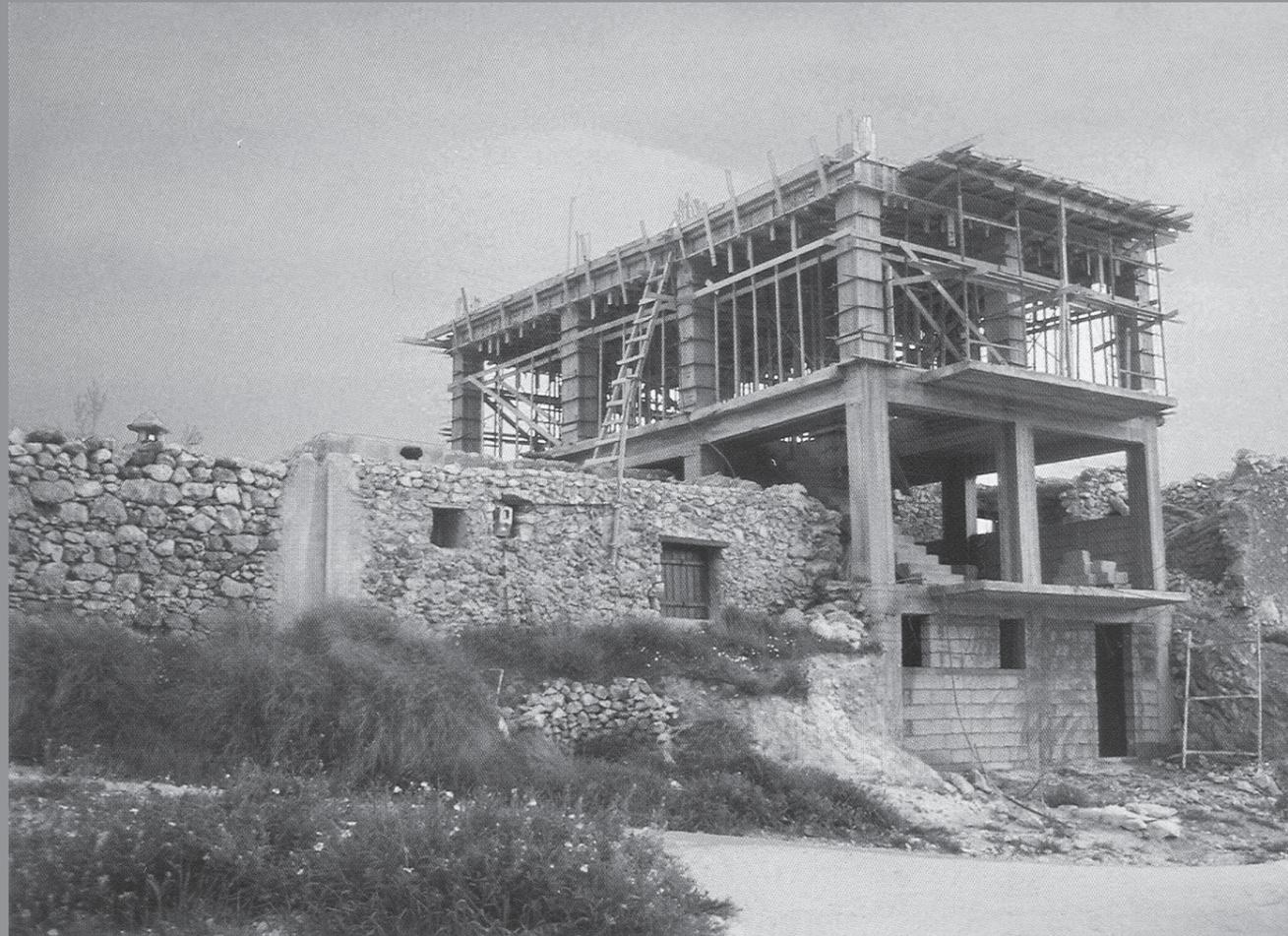


*POLYKATOIKIA UNDER CONSTRUCTION*

*SOURCE: FROM DOM-INO TO POLYKATOIKIA. PIER VITTORIO AURELI, MARIA S. GIUDICI, PLATON ISSAIAS. DOMUS. 2012.*

Today, around 70% of all urban building stock in Athens consists of a reinforced concrete structure<sup>24</sup>. Most of these buildings consist of concrete slabs, beams, pillars, and foundations, which are poured on site into in-situ moulds. This is vastly different to the masonry construction found among most buildings constructed around the beginning of the 20th century, which declined after the war due to an increase in clay production in Greece. The use of reinforced concrete throughout Athens has vastly improved the likelihood of survival of a structure during seismic activity. Since the Thessaloniki earthquake in 1978 and the Athens earthquake in 1999, the Greek Seismic Code has been revised extensively, which has led to the imposition of stricter regulations and design practices with regards to the structural assessment of reinforced concrete and steel structures throughout earthquake zones. Due to the revisions made to the Seismic Code, many if not all buildings constructed between 1950-1980 do not meet the current regulations and require intervention to strengthen the structures. Financially, it would not be feasible to strengthen all these structures, so the decision was made to only reinforce structures of high societal interest, such as schools, hospitals, buildings of historical significance, and other public buildings.

24. State of The Art: Greece. L.Baniotopoulos, D.Bikas, T.Stathopoulos. Improving the Quality of Existing Urban Building Envelopes. 2007.



SELF-BUILT DOMESTIC UNIT IN THE PERIPHERY OF ATHENS

SOURCE: DIMITRIS PHILIPPIDES, MODERN ARCHITECTURE IN GREECE (ATHENS: MELISSA PUBLISHERS, 2001)

The updated building guidance also saw the introduction of thermal insulation, to better establish energy and environmental considerations into construction. This has since changed the way external building elements are constructed, such as pillars, beams, roofs, and floors. In Greece, thermal insulation is located on the exterior side of the bearing elements, which contrasts to traditional UK construction where insulation is generally located on the internal side of bearing elements, with a cavity gap on the exterior to allow for air flow throughout the structure. The most common materials used for thermal insulation are extruded polystyrene and glass wool.

These controls help to maintain the integrity of buildings during earthquakes and extensive heat waves, however there is little to no guidance on flood prevention and wildfire protection. Standard practice sees governmental response after the disaster, through insurance pay-outs and lacklustre funding towards vital services<sup>25</sup>. In 2021, the number of wildfires in Attica in July was 26% higher than average of the past 12 years, with the total area burned over 450%. Greek civil protection authorities, including the Hellenic Fire Service, have blamed the lack of prevention plan and underfunding of forest protection services on slow response to disasters.

25. The Greek wildfires: What went wrong and what can be fixed? M.Tsimiakos. Aljazeera. 2021.



## Exploring the just transition Europe



C40 CITIES "JUST TRANSITION" COVER  
SOURCE: C40 CITIES. 2021.

Prime minister, Kyriakos Mitsotakis, has been vocal on blaming the rise of disasters on an ever-changing climate, while also admitting to governmental failure. To tackle the increase in temperatures in the city, the government have introduced an integrated Climate Action Plan, which sees ambitious plans to reduce greenhouse gas emissions by 40% by 2030 while helping the city to adapt to climate change. This is known as the C40 Cities Climate Action Plan<sup>26</sup>.

The aimed actions included in the plan are: -

A) Adaptation to climate change, through the reduction of temperature and the creation of suitable conditions, with key strategic points:

- Green Areas: Creation, expansion, maintenance of green spaces, classics such as parks but also new forms, such as vertical plantings
- Integration of water elements
- Public spaces designed appropriately, with shading, cold materials
- Information, awareness, education of citizens and services

B) Reduction of greenhouse gas emissions, through the most efficient use of energy, with key strategic points:

- Reduction of energy consumption from public buildings and infrastructure
- Reduction of fuel use
- Promotion of gentle forms of movement
- Improving biodegradable municipal waste
- Pilot intervention in the commercial triangle, with sidewalks, use of cold materials, lighting of new technology and upgrade of urban equipment
- Maintenance of green spaces
- Green roofs in school buildings
- Energy upgrades in 4 school complexes
- Construction of 2 bioclimatic nurseries
- Connection of school buildings with natural gas and exemption from the use of heating oil
- Purchase of vehicles with lower fuel consumption

26. The Municipality of Athens, the first municipality in Greece with an Integrated Action Plan for Climate Change. Cityofathens.gr. 2017.



GEORGIOS KAMINIS  
SOURCE: GREEK TRAVEL PAGES. 2018

Georgios Kaminis, Mayor of Athens, had this to say about the Climate Action Plan.

"It is now clear that cities are more effective in fighting climate change in comparison to the states. Where national governments fail to act, we – the cities – take the lead and undertake action to limit global temperature rise, reduce energy costs, protect vulnerable groups, and safeguard the quality of life in cities. Athens benefits from its participation in large cities networks, like C40 and 100 Resilient Cities, by exchanging experience with other cities to deal with our common problems and fully supports the Global Covenant of Mayors for Climate & Energy. It is important to highlight that the city has made significant progress getting also technical support from the above-mentioned networks at no cost for the city."

*Ξανασκέψου την Αθήνα*

*RE-THINK ATHENS*



RE-THINK ATHENS STREET SECTION  
SOURCE: OKRA, 2017.



RE-THINK ATHENS MASTERPLAN  
SOURCE: OKRA, 2017.



RE-THINK ATHENS RENDER  
SOURCE: OKRA, 2017.

In response to governmental guidance from the Climate Action Plan, Netherlands Landscape Architect's firm OKRA, have proposed an open space intervention for the city of Athens known as Re-Think Athens. The proposal in simple terms creates a walkable city that will "reverse the downward spiral of the city centre that has been ongoing since the 1980s".

OKRA have identified explosive growth over decades that have created both a socio-cultural imbalance and infrastructural issues across the city including accelerated poor economic conditions, poor quality of residence, and severe environmental degradation due to a lack of urban green space. To tackle these issues and more, OKRA have proposed a transformation of the City Triangle back into a vibrant modern metropolitan city centre by traffic flow reduction, climate control and public realm programming to create a vibrant, accessible city<sup>27</sup>.

27. Re-think Athens Winning Proposal/OKRA. A.Furuto. Arch Daily. 2013.



RE-THINK ATHENS 1000 ROOMS THEATRE SECTION  
SOURCE: OKRA. 2017.



RE-THINK ATHENS VEGETATION COOLING SYSTEM  
SOURCE: OKRA. 2017.

By introducing a green framework into the city that includes attributes towards reducing urban heat island (UHI) effects, the city is naturally cooled by use of greenery, adaptive paving, earth cooling, and water storage and reuse. The proposal sees 800 trees planted in the city centre, that will have a positive impact on energy flow and consumption, while reducing air pollution. These trees will naturally create shading to cool the pavements allowing for cooler ground floor levels and streets that can be used throughout the summers. This will reduce the temperatures by as much as 3°C.

Another aspect of the green environment is water retention. As Athens has a dry climate during the summer months, retaining and reusing water is valuable. The system put in place will allow for collection and transportation of rainwater which will meet the city centre's need for irrigation, including enough water to clean the streets regularly. OKRA believe that this rainwater collection and storage system could be an example for other Mediterranean cities.

The Re-Think Athens proposal is a great example of transforming the city to live with and reduce the effects of climate change. The pedestrianised streets and proposition for repurposing abandoned buildings allows for revitalisation of the city centre while cooling the city and reacting to flash flooding.

*συμπέρασμ*

*CONCLUSION*

As established, the current governmental response to disasters is for citizens to take out an insurance policy for their property, that may take years to settle and in turn take years for re-building. Public services such as police and fire services are severely underfunded, causing a delay in response and therefore allowing more damage to be done. Forest protection services are also underfunded, while illegal building continues of flood prone areas making it harder for climatic disasters to naturally occur and cause less damage.

Prime minister, Kyriakos Mitsotakis, has described citizens' as gaining a "culture of evacuations" which is not an ideal response when thousands of residents are displaced every year from climatic disasters.

Climate change is an unstoppable force that we have a duty to respect. Recycling, reducing carbon emissions and planting more trees may slow the rate of a changing climate, but we must learn to live with the reactions of the earth from years of damage. As humans, we have learned to adapt and overcome many issues, so why can't we do the same with our ever-changing climate?

At the rate the climate is changing, Athens may end up underwater from high water table levels sooner than expected or become a city of ruins burned to the ground. With a lack of governmental funding to essential services such as forestry maintenance and the fire service, it is obvious that the community needs a new plan of action through construction and urban planning to tackle the issues at ground level. From rebuilding homes for displaced citizens using culturally appropriate semi-permeant housing over typical tents, to constructing future proof streets and buildings that will allow for continued use throughout a disaster.

The future of Athens relies on proposals such as Re-Think Athens to redevelop the city back into a liveable city, where carbon emissions are lowered, and the streets are cool and walkable. The government also needs to maintain progress with the Climate Action Plan, making big changes throughout the city that will influence other cities to reduce climatic impact around the world.



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***How did you get involved in international disaster response?***

Hurricane Katrina had hit the Gulf Coast in 2004, it hit the headlines in a new way. The terror attacks on September 11th in New York changed the way I viewed news, I was hooked on the idea of assisting in some way. I had building experience before attending University and I felt I could physically help rebuild homes. Naively, in 2005 I boarded the plane and arrived in Biloxi, Mississippi to see, first hand the recent physical destruction that Katrina had caused. I can remember the moment I knew this would change the way I worked. I began volunteering with a group (Hands on Gulf Coast, now All Hands and Hearts), they were founded by David Campbell further to the Tsunami in Indonesia. I went from a volunteer visit to spending most of 2006-2007 rebuilding homes. It was several years later that I worked for the organisation, an opportunity which led to working with IOM/ UN Migration.

***What governmental actions did you have to take in order to build more sustainable semi-permanent housing over traditional disaster responses?***

This is an interesting moment in Tacloban City, Philippines in 2014 further to Typhoon Yolanda - I was working and representing an International Non-Governmental Organisations (INGO) at UN Cluster meetings and Government housing meetings weekly and pushing for systematic building practice in order to employ Internally Displaced People (IDP's). Attending these meeting were many other INGO's (Oxfam, Red Cross etc.) as well as other UN groups which work WITH the local government such as IOM (International Organisation for Migration) which are Inter-governmental Organisations and assist the government with specialist aid and advice.

I had the unique opportunity, due to the size of our organisations to live and work directly with locals, we would have conversations that went on long into the night. Not talking about architecture or engineering but about dignity, respect and what people were looking for in long term disaster response. We broadly discuss 'Shelter' and the speed at which shelters are built, rarely were these meetings discussing the long term needs of the affected local community. We had many looking for work and wanting to see their community be strong again after a lifelong disaster fatigue. Many local workers had skills many didn't. My team and I, after seeing the level of skills in the community, developed a naive training package with simple designs using local materials, providing cooking stations, land to grow which was presented to the local government from a small INGO. It took several months to convince that this would work well in the long run, the Local Government were increasingly supportive, and our projects received the funding from other INGO's. There was little talk about Semi-Permanent housing, it was regarded as a 'Transitional' shelter with training. We successfully trained over 400 local workers capacity building the local villages, many remained in work, with some returning to other homes to share the knowledge of 'build back better'. To succinctly answer the question is difficult as the 'traditional' disaster response is to get immediate shelter; this isn't wrong, we just seen opportunity in every level of the design process, this included semi-permanent considerations, which were adopted, and these shelters are still standing and accommodating families.

***What are the benefits of constructing semi-permanent housing over temporary housing such as the Ikea Temporary House?***

From my experience, and I have to get my hierarchy of 'Shelter' correct here- (from tent, tent up-grade, transitional shelter, core shelter, permanent housing), semi-permanent shelter does exist as a unconscious, undefined shelter option- if it is 'safe' it is habitable? I think it comes down to the standard of what we want families to tolerate, the terms above seem to blend or sometimes, due to many different problems (more storms, more floods etc) do not flow as effectively as intended.

UN Shelter Cluster uses Sphere Standards and HAP Standards to instruct the designers construction methodology, however, it is down to the Government to react to creating a safe shelter for displaced people,

I can't imagine some of the decisions that are made following disaster, where we aim at any level to 'do no harm'. Companies and Organisations are designing and implementing many quick response housing following disaster, not all will work not all will fail.

I think my response to this question of why semi-permanent Housing/ Shelter has benefits is due to the 'slow architecture', that is being given the time to develop, not just a house design, but what are all the problems and opportunities in responding. We don't always have that time to react efficiently or with the whole picture.

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***What would you like to see implemented across the design and construction industry to prevent mass destruction when it comes to environmental disasters?***

I'm certainly not qualified to answer this. I hope in these answers I haven't left out that each disaster has its own unique set of problems, culturally, religiously, cause, environment, vulnerability before and after the disaster, as well as the ugly side of people's intentions that lead to scams, people trafficking and fraud.

What would I like to see implemented? Something that tells us when a disaster will happen would be great! I would like to see good, effective preparedness in place whilst we are developing strategies to deal with what the climate has in store for us. Education of what vulnerability looks like and that we are all vulnerable but some have more to lose...

I would like to see Disaster Preparedness and Response become a main subject in design and construction.