

An Resilience Research Platform: Streamlining the Resiliency Research Workflow for Architecture Teams

Student Researcher: Yongqin Zhao, M.S. Arch Design Tech Candidate

ARC Advisor: Flavia Grey (ZGF Architects), Karen Chen (UW)

Thesis Committee: Narjes Abbasabadi (UW), Heather Burpee (UW)

Index

What we have already set as research context

1. Background, Research Question, Objectives, and Gaps

What we learnt from the current practice

1. A Comprehensive Resilience Research Workflow
2. Current State of Resilience in Practice: Survey and Workshop Feedback

How we decided to tailor a comprehensive workflow at critical stages

1. Essential Workflow: **quick, deep, direct research** in **very-early-phase**, with a web-based platform

What is the deliverable, how design team can use the workflow

1. Platform Development

Index

What we have already set as research context

- what is resilience, what are resources used in design, what is the current state.

What we recently learnt from the current practice

- What is a Workflow, why the workflow matters
- Where in the workflow that designers meet barriers, what they hope to see improvement

How we decided to tailor a comprehensive workflow at critical stages

- When and how design team would use this,
- How “agile” it can be

What we will developing for this topic

- The Platform -> A Digital Tool Housing the Workflow

What is Resilience in Architecture

Resilience is scientifically defined as: the ability of social, economic, and environmental systems to **resist hazards and maintain essential functions**. ¹

According to AIA, resilience can be represented in the built environment through five forms: Health, Social, Infrastructure, Environmental, and economic resilience. ²

From **a temporal perspective of a building facing a hazard**, resilience can be defined as **the ability of a building to prepare for, and resist against (through the durability of its structure and other building system, as well as flexibility of space usage), and recover from nature hazard**. ³



¹: AR5 Synthesis Report: Climate Change 2014 — IPCC

²: Resilience Design Toolkit, Resilience Design Integration for Architectural Projects. Shams, et. al.

³: From the 3 R's Rule of Sustainability to the 4 R's of Resilience: an Architectural Approach. Di Pilla, et. al.

Image: Dozens get rescued from roof of a hospital during flooding from Hurricane Helene in Erwin, Tennessee. Source: Virginia State Police (top), USA TODAY NETWORK via Imagn Images (bottom)

Current Literature Discussion

Topic

1. Resilience **Assessment and Evaluation**: Scorecards, performance metrics, multi-dimensional indicators.
2. **Urban and Regional Planning & Policy** for Resilience: Policy integration, spatial planning, zoning.
3. **Public Health and Critical Infrastructure** Resilience.
4. Data-Driven and Technological Approaches to Resilience: **Big Data, simulations, digital modeling**.
5. **Sustainable Building and Green Infrastructure**: multi-hazard architecture, climate adaptation.
6. **Community and Stakeholder Engagement**: Participatory modeling, human-centered approaches.
7. **Disaster Recovery**: long-term resilience planning and Post-Disaster Development

Deliverables and research types

1. **Conceptual (definition & strategy) frameworks** for structuring resilience.
2. **Assessment tools and metrics** for measuring resilience (scorecards, etc.).
3. **Case studies and empirical applications** for real-world implementation.
4. Data-driven **models** and **simulations** for **predictive** resilience.
5. **Systematic reviews** and **research agendas** summarizing resilience literature and future directions.

Current Literature Discussion

A lot of them are focusing on “single-point” advancement: better modeling and prediction, better. They are about *“how to bring TASK_A to next-level”*

But, how can the design team, in daily practice, use these advanced research?

There is a gap in *“how to make everyone accessible to TASK_A”*

Research Questions

1

What are the **current resources and challenges for project teams** to implement resilient design, in various design phases, under a specific project scope?

Answered by
the survey



2

What resources are used in various tasks?

What can project team benefit from a resilient design **workflow**?

3

How to develop a systematic tool to support the project team throughout various phases, under a specific project scope?

A web-based
platform



Research Gap

	Research Gap	Research Opportunity	How to address
Literature -> Practice	Existing literature heavily focus on “how to bring TASK_A to next-level” . But not “how to make TASK_A accessible to everyone”	Build an end-to-end, accessible platform to house mostly familiar tasks	Develop a web-based, interactive platform with:
Practice	Lack of structured and easy-to-onboard workflow: free-style googling is feasible but expensive, existing workflow is sophisticated but still conceptual	Develop an enhanced workflow with wider coverage of context and higher resolution in each step: common tasks suggested for this project context, related resource, liaison and consultants, expected deliverables, and multi-level coordination. <i>“How should I start, where is supporting material, what to do now, what’s next”</i>	A guided, easy-to-pick-up workflow
Practice	Current research material is rich, but scattered and hard to navigate .	Better Resource Navigation: Provide an outlined directory by organizing resources by type, topic, georegion, etc. This database would offer easy-to-search and contextual resource navigation. <i>“what hazard, what risk, what precedent, what strategy”</i>	Effective resource navigation

Research Objective

This project focuses on **developing a platform** that provides project teams with a more accessible and user-friendly approach to **streamline the resilience research workflow** that can:

- Provide a guided, easy-to-pick-up **workflow**, with essential data injected
- Navigate **resource** effectively, including precedent, strategies, tools, support, etc.;
- Offer a high-level guide for new projects, incorporating precedent library, resource navigation, and existing tools to an **interactive platform**.

The workflow

Define Scope	► Build Team	► Identify who & What	► Assess Vulnerability & Risk	► Develop Strategy	► Evaluate & Select Strategy: CBA, BCA	► Evaluate after construction
Identify client expectation & deliverables, and knowledge of resilience Educate awareness through conversation: importance, examples, cost, return, adoption, etc.	Assemble the team with various disciplines and expert consultants. Align project delivery and minimize confusion. Set up meetings, workshops with team, analysis and document.	Identify stakeholders Identify major hazards Identify assets, design aspects, and design expectations (criteria).	Vulnerability: which stakeholders and features could be impacted Likelihood of hazard Consequence of hazard Risk Assessment for each [hazard] - [asset and stakeholder] pair Prioritize hazards with Risk Assessment Matrix Stress vs shock: Future Projection	primary and secondary Impact-Asset Pair for identified hazard. [Hazard] - [Design Criteria, expected building performance] pair list design considerations of building components design considerations of other principles Strategy Library	BCA: Collect and determine property value BCA: Characterize Impacts and Determine Damages & Hazard Mitigation Analysis BCA: Cost analysis of each [potential strategy - damages avoided] pair CBA: Ranking based on feasibility + impact CBA: Use Owner's rubric, pick the best one for owner	Post Occupancy Evaluation

02 A Comprehensive Workflow

Cool!

But, this is “ideal”, or “resourceful”.

***How do design team perform resilience research
in their everyday practice?***

Current State of Resilience Research

How can a design team use this workflow?

A survey is designed to help collect these ideas,

So that a tool can be developed from the workflow to address to designers' concern.

Objective 1: How designers have their current resilience research

- What is their knowledge level, experience level, and hazards faced
- Some experiences and resources to share with

Objective 2: What are the barriers

- What are the barriers, where they come from

Objective 3: Who have, and where are the barriers for them

- For a respondent as [role] in [discipline], at which [project phase] they have this barrier

Objective 4: What are the improvements they want to have

- What are some helpful solutions but currently lacking

Survey Questions

Part 1: Respondent's Background

- Firm information
- Discipline
- Role
- Project Typology Experience
- Design Phase Experience

Part 2: Respondent's Resilience Experience

- Knowledge Level
- Project Experience (count)
- Hazard addressed
- Belief of "Urgency of resilience"
- Barriers
- Design Phase when having barriers
- Improvements needed but currently lacking

Part 3: Respondent's Sharing and further participation

- (Optional) story to share
- (Optional) interest in further research



Scan this QR code or
use this [link](#) to revisit
the survey questions

Survey Respondents

71 Respondents from **ZGF**

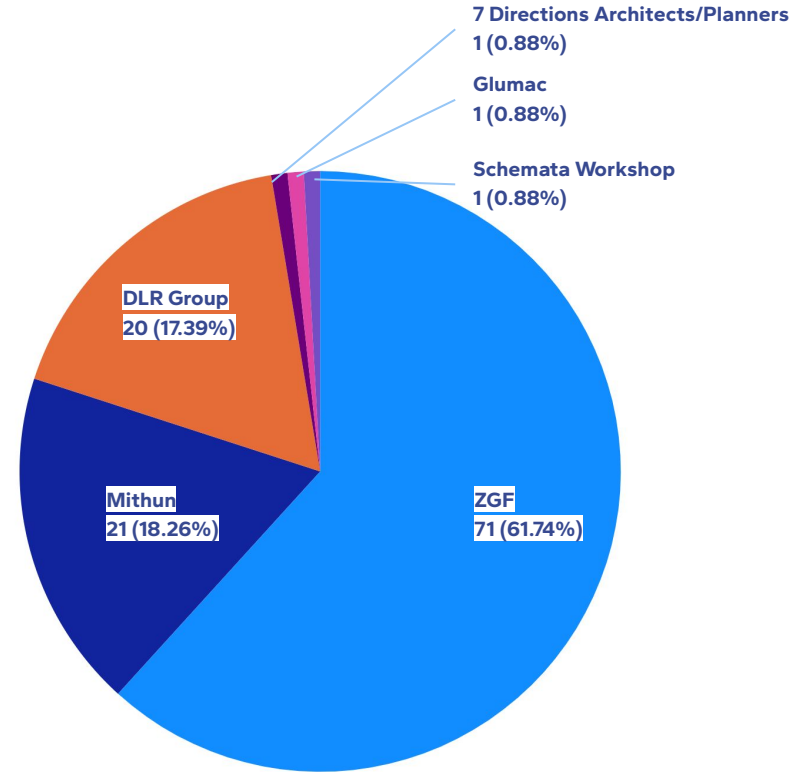
44 Respondents from **other firms**

- 7 Directions (1)
- DLR Group (20)
- Glumac (1)
- Mithun (21)
- Schemata Workshop (1)

ZGF would be the main scope, given:

- Respondents represent broader audience, given proportion of respondents in their firm,
- Further research be developed, investigation and data availability

but all respondents' responses would serve for validation and further implication, and their insight on barriers and opportunities are valuable



Barrier Summary

- **Client**
 - Justification of implementing resilience: **why this is necessary, how it can be beneficial**
 - Feasibility and effectiveness consideration: **how to implement**
 - Budget consideration: **what is the cost**
- **Design Team**
 - Hard to navigate resource: **what hazard is there, what is the risk on my design, which resource should I reference**
- **Resource(s) for communication and learning**
 - Resource for hazard identification and risk assessment
 - Precedent for demonstration of resilience implementation
 - Tools for quantify cost/benefit

Opportunity Summary

- **Organize material by**
 - Typology
 - Geographic zone
 - Climate Zone
 - Design system
 - Design Material
- **Quantify cost for**
 - What if & what if not
 - Lifecycle & up-front
 - ROI
- **Learn and Communicate with distillation of the topic**
 - Impact of hazard, Successful precedent(s), benchmark
 - hazard-specific generic solutions that can be the starting point
 - Specific strategy: "Implementing XX strategy will cost approximately \$XX and will be XX% impactful in XX scenarios"
 - Graphic

Scope Building

- **Stage Considered: very early phase**
 - Early engagement with client on the necessity and scope is essential for all later phases
- **Audience Considered: Design Team (maybe with limited knowledge in resilience)**
 - They are the majority in most design firms,
 - Firms may hope to see some early-stage effort **in house**.

03 Survey Result

Can we further narrow down the scenario?

“If there is such a tool, where and how you would like to use it”

The 7-step workflow is “a guide”, not a protocol user has to follow

Define Scope	► Build Team	► Identify who & What	► Assess Vulnerability & Risk	► Develop Strategy	► Evaluate & Select Strategy: CBA, BCA	► Evaluate after construction
Identify client expectation & deliverables, and knowledge of resilience Educate awareness through conversation: importance, examples, cost, return, adoption, etc.	Assemble the team with various disciplines and expert consultants. Align project delivery and minimize confusion. Set up meetings, workshops with team, analysis and document.	Identify stakeholders Identify major hazards Identify assets, design aspects, and design expectations (criteria).	Vulnerability: which stakeholders and features could be impacted Likelihood of hazard Consequence of hazard Risk Assessment for each [hazard] - [asset and stakeholder] pair Prioritize hazards with Risk Assessment Matrix Stress vs shock: Future Projection	primary and secondary Impact-Asset Pair for identified hazard. [Hazard] - [Design Criteria, expected building performance] pair list design considerations of building components design considerations of other principles Strategy Library	BCA: Collect and determine property value BCA: Characterize Impacts and Determine Damages & Hazard Mitigation Analysis BCA: Cost analysis of each [potential strategy - damages avoided] pair CBA: Ranking based on feasibility + impact CBA: Use Owner's rubric, pick the best one for owner	Post Occupancy Evaluation

Essential Part of the workflow will be considered in the platform

Define Scope	Build Team	Identify who & What	Assess Vulnerability & Risk	Develop Strategy	Evaluate & Select Strategy: CBA, BCA	Evaluate after construction
"Quick, Direct, Deep" Research in very early phase, bring the outcome to client communication Example: CBA, BCA, etc.	Assemble the team with various disciplines and expert consultants. Align project delivery and minimize confusion. Set up meetings, workshops with team, analysis and document.	Identify Hazard: Hey, what hazards have happened before? Identify [hazard] and features that could be impacted [hazard] - [asset and stakeholder] pair Consequence of hazard on building system Prioritize hazards with Risk Assessment Matrix Stress vs shock: Future Projection	Assess Hazard on Building: which [hazard] and features could be impacted What is the top prioritized hazard considering impact on building system [hazard] - [asset and stakeholder] pair Prioritize hazards with Risk Assessment Matrix Stress vs shock: Future Projection	What strategy can I use? What case studies have this before? What other [resource] could make this [necessary and doable] Fund, benefit, others. Strategy Library	BCA: Collect and determine property value BCA: Characterize Impacts and Determine Damages & Hazard Mitigation Analysis BCA: Cost analysis of each [potential strategy - damages avoided] pair CBA: Ranking based on feasibility + impact CBA: Use Owner's rubric, pick the best one for owner	Post Occupancy Evaluation

These are also the most "resource-oriented" steps.

04 What is this platform

By Whom

Architecture design team (regardless of their experience).

As revealed in the survey, most participants have highly overlap on barriers , where they have barriers, and hazards.

What scenario?

Very early phase research: to quickly & directly understand

- What hazards are there
- What project has addressed this before, (case study)
- What action would be suitable (strategy)

So that this can be wrapped up and used to persuade the client

What is this platform? Is not?

“This research **is not producing** resilience architecture **knowledge**, **but build tools to bring** resilience **resource** and **knowledge**, public or within firm, **to the design team**”

Is:

A platform that users are provided

- A guided **research** for case study, strategies, and other hazard resource
- A toolkit to contribute (**upload & format**) their data.

Is not:

An expert-level resilience knowledge base

04 What is this platform

~~A state of the art & closed knowledge base?~~

An open and scalable toolkit.

Users would be fully responsible for validating and uploading their data with a toolkit. (experienced designer or resilience champion can lead this)

Current data in this platform is just for demonstration of core functionality - search + contribute .

This platform can bring up resource from trusted source (FEMA, ASHE, AIA) and even organization precedent (firm's internal knowledge).

Why this is important

Public Resources are their, but they are scattered. (AIA hub, CHD, FEMA, HHS)

Google everything is still doable, but, takes a long time. (expert can be quick, but less-experienced might spend a long time)

Company knowledge usually lived in static file (text document, sheet, blogs).
Can they be more accessible (direct, easy to get) **and interactive** (use and contribute)?

A “guided, direct” research can save time!

Essential Steps

1) Identify hazards: Search by State, County

- use FEMA api to get historic hazard
- User can select hazard

2) Risk assessment for identified hazards:

- A **step-by-step wizard**, From identify impacted system, hazard likelihood assessment, to risk score calculation
- User then select risk (hazard-system) of concern

3) Navigate Resource

- Build specific project context
- Search case study
- Search strategy
- Search other resources (fundings, best practice)

4) Summarize previous steps

- Collect previous information and documentation

05 Platform Development

Demo!

[RRP_DRAFT v3B.mp4](#)

With help from my ZGF colleague Lahmi Kim

Step 1

Search Hazard by Location

Search by State Code

State Code (e.g. WA)

FETCH FEMA DATA

Search by County, State

County, State (e.g. King, WA)

Harris, TX

FETCH FEMA DATA

Time Range Filter

Start Date

mm/dd/yyyy

End Date

mm/dd/yyyy

2 search modes

Time Filter

IncidentType Frequency

Select Hazard

☒ Hurricane

☒ Flood

☒ Severe Ice Storm

☐ Biological

☒ Severe Storm

☒ Fire

☐ Other

☐ Coastal Storm

☐ Tornado

Hazard Type	Frequency
Hurricane	18
Flood	9
Severe Ice Storm	5
Biological	4
Severe Storm	9
Fire	9
Other	1
Coastal Storm	2
Tornado	1

Selected Hazards: Hurricane, Flood, Severe Ice Storm, Severe Storm, Fire

CLEAR SELECTED HAZARDS

Disaster Records of Selected Hazards

Type: Hurricane

Begin: 2024-07-05 | End: 2024-07-09

Type: Hurricane

Begin: 2024-07-05 | End: 2024-07-09

Type: Flood

Begin: 2024-04-26 | End: 2024-06-05

Enter a location

Filter by time (optional)

Compare and select hazard

Step 2.1 Assess Impact

Select Systems

CLEAR CURRENT INPUT

Select system

☒ Architectural Systems ☐ Civil Engineering Systems ☐ Emergency Preparedness, Planning and Response
☐ Human Systems ☐ Landscape & Ecological Systems ☐ Mechanical & Plumbing Systems ☐ Power & Electrical Systems
☐ Structural Systems

Selected Systems Detail

System / SubSystem	Hurricane	Flood	Severe Ice Storm	Severe Storm	Fire
^ Architectural Systems	—	—	—	—	—
Canopies, overhangs, awnings, external shading structures, balconies	5	3	4	5	5
Entryways and exits including street access	2	1	1	5	3
Façade, cladding, siding, building envelope, weather sealing, air or vapour barrier systems	5	3	2	5	5
Roofing	5	2	4	5	5
Windows, doors, fenestration	5	4	1	5	5

Add New System / Subsystem

Add New System

System Name

ADD SYSTEM

Add New SubSystem

System

SubSystem Name

ADD SUBSYSTEM

The building system-subsystem is loaded as a template,

- originally from City of Vancouver Building Resilience Planning Worksheet

The impact score still require architecture knowledge,

- Maybe “semi-auto calculator” in the future?

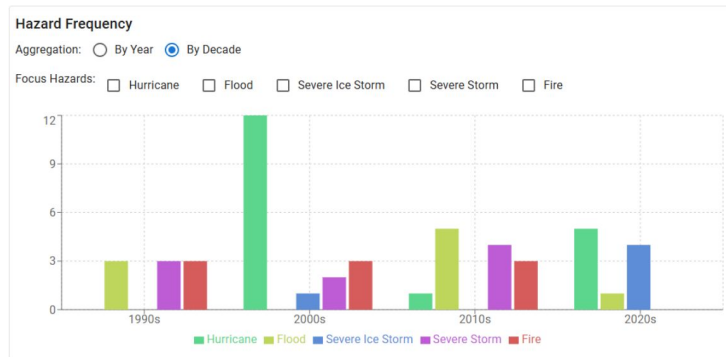
Step 2.2 Assess Likelihood



The previously fetched FEMA hazard data is displayed in detailed,

The likelihood score still require architecture knowledge,

- If we can have data from insurance company...



Step 2.3 Prioritize Risk

$$\text{Risk} = \text{Exposure} \times \text{Consequence} \times \text{Likelihood}$$

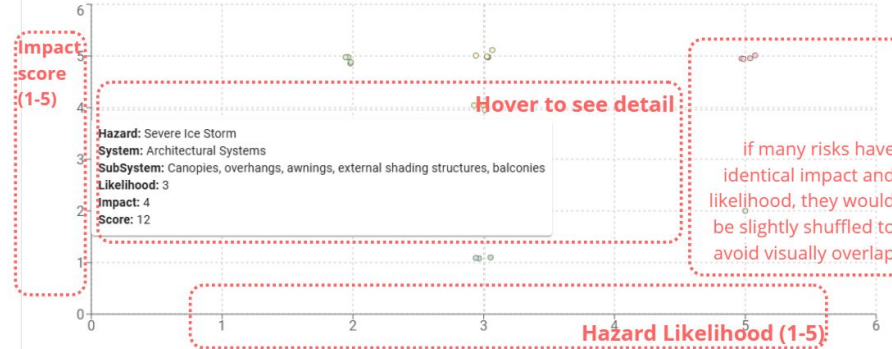
0 or 1 1 to 5 1 to 5

Select risks that should be prioritized

- City of Vancouver suggested that any risk ≥ 10 should be considered

Risk Matrix Visualization

Scatter Plot: X = Likelihood, Y = Impact, Dot Color = RiskScore



Sort By: Risk Score Desc

Select	Hazard	System	SubSystem	Impact	Likelihood	RiskScore
☒	Hurricane	Architectural Systems	Canopies, overhangs, awnings, external shading structures, balconies	5	5	25
☒	Hurricane	Architectural Systems	Windows, doors, fenestration	5	5	25
☒	Hurricane	Architectural Systems	Roofing	5	5	25
☒	Hurricane	Architectural Systems	Façade, cladding, siding, building envelope, weather sealing, air or vapour barrier systems	5	5	25
☒	Severe Storm	Architectural Systems	Windows, doors, fenestration	5	3	15
☒	Severe Storm	Architectural Systems	Canopies, overhangs, awnings, external shading structures, balconies	5	3	15
☒	Severe Storm	Architectural Systems	Entryways and exits including street access	5	3	15
☒	Severe Storm	Architectural Systems	Façade, cladding, siding, building envelope, weather sealing, air or vapour barrier systems	5	3	15
☒	Severe Storm	Architectural Systems	Roofing	5	3	15
☒	Flood	Architectural Systems	Windows, doors, fenestration	4	3	12

Selected risk will be visible in next step

Step 3 Send better (structured) question to AI

Resilience Platform

1 Identify Hazard ————— 2 Assess Risk

Step 3: Navigate Resource

Guidance & Explanation

"docType"

TASK A: CASE STUDY TASK B: STRATEGY TASK C: ...

Enter your query

User Query

Give me some examples, ideally in Texas

ASK SUMMARY BUILD GRAPH

Summary

Graph Visualization

Search Results:

- The University of Texas MD Anderson Cancer Center in Houston according to U.S. News & World Report.
- This recognition underscores the center's commitment to health Harris County, Texas.

Row 1235 at fema-case-studies.csv

User can define context in the panel

Context Panel

Project Context

Climate Hazard(s)

☒ Flooding ☐ Drought ☐ Extreme Heat Wave ☐ Sea Level Rise ☐ Landslide

☒ hurricane ☒ severe ice storm ☒ serve storm ☒ fire

Add custom hazard ADD

hurricane ✕

severe ice storm ✕

serve storm ✕

fire ✕

Code/Regulatory Requirement

☐ Building Height Limit ☐ Nature Reserve

Add custom regulatic ADD

Project Type

☐ Civic Infrastructure ☐ Residential ☐ Commercial ☒ healthcare

Add custom projectT ADD

healthcare ✕

A combined message

docType: Which type of file

Context: What is the project context

User Query: What do you want to know

will be sent to AI

Step 3 Display a single result

LLM Summary

Metadata

Original text

(<https://www.fema.gov/case-study/hazard-mitigation-plan-integration-driven-relationships>)

Hazard Mitigation Plan Integration: Driven by Relationships

In 2012, Larimer County, Colorado experienced a major wildfire, followed by a major flood in 2013. Many residents were isolated by these events, either through damage to infrastructure or communications systems. These two disasters showed gaps in the county's emergency capabilities and public safety information outreach.

Region 8, Colorado

Fire, Flood

Possibly matched

Context & Certifications

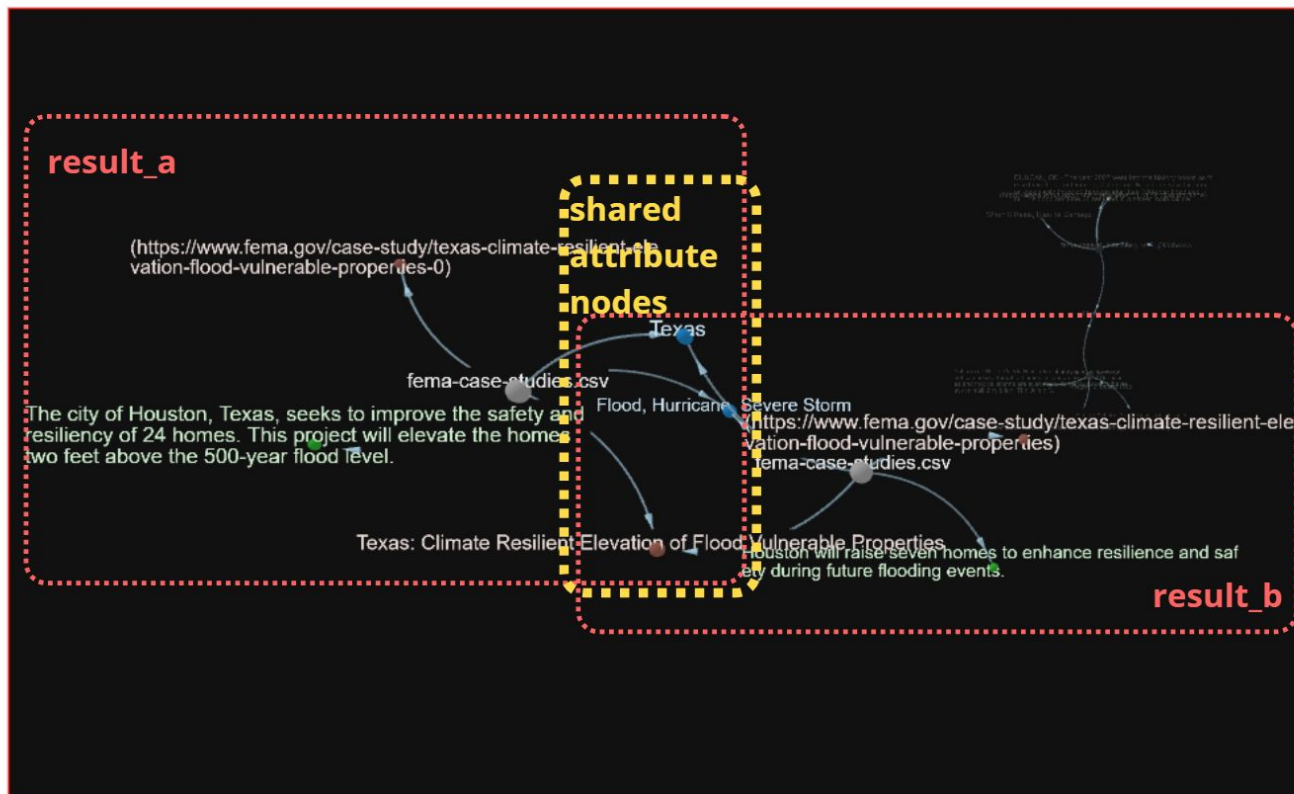
Construction Design and Materials in Wildland Areas
Follow the guidelines of NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire.

- RELI Version 2.0, HA Req. 4.0 – Safer Design for Extreme Weather, Wildfire + Seismic Events

ADD TO COLLECTION

Step 3 Compare Multiple Results

Still beta version



Step 3 Summarize Multiple Results

1 * Global (multiple results from multiple files)

Summary of All results

+

Reference of All results

n * File-level (multiple results from one file)

Summary of All results in this file

+

k * Description of each result

Global Summary

The city of Houston, Texas, is actively working to enhance the resilience of its homes in response to the severe impacts of past flooding events, particularly those caused by Hurricane Ike and Tropical Storm Allison. Plans are in place to elevate 24 homes above the 500-year flood level, with a focus on improving safety and preparedness for future storms. The community's experiences with catastrophic flooding have underscored the urgency of these measures, as residents vividly remember the chaos and destruction caused by these natural disasters.

Houston's proactive approach reflects a broader commitment to disaster preparedness and community safety, aiming to mitigate the risks associated with severe weather events. By investing in infrastructure improvements, the city is taking significant steps to ensure that it can better withstand the unpredictable nature of future storms, ultimately fostering a more resilient environment for its residents.

Sources:

fema-case-studies.csv, row 50
fema-case-studies.csv, row 148
fema-case-studies.csv, row 681
fema-case-studies.csv, row 1184
fema-case-studies.csv, row 1185
fema-case-studies.csv, row 814
fema-case-studies.csv, row 821
fema-case-studies.csv, row 1099
fema-case-studies.csv, row 1235

Global Summary

OPEN
PANEL

Reference for Global Summary

File: fema-case-studies.csv

The city of Houston, Texas, is taking proactive measures to enhance the safety and resilience of its homes in response to the devastating impacts of past flooding events. Plans are underway to elevate 24 homes by two feet above the 500-year flood level, with seven of these homes specifically targeted for elevation to better withstand future flooding. The urgency for such improvements is underscored by the catastrophic effects of Hurricane Ike in 2008, which caused extensive damage with a 12-foot storm surge, and Tropical Storm Allison in 2001, which resulted in 37 inches of rain in just 12 hours, leading to significant loss of life and \$5 billion in damages across 31 counties, including Harris County.

These historical events have left a lasting impression on the community, with residents recalling the nightmare of Tropical Storm Allison and the chaos during Hurricane Rita, which prompted emergency evacuations. In light of these challenges, Houston's efforts to elevate homes reflect a commitment to improving resilience against future storms, ensuring that the city is better prepared for the unpredictable nature of severe weather.

The city of Houston, Texas, seeks to improve the safety and resiliency of 24 homes by elevating them two feet above the 500-year flood level.

Source: fema-case-studies.csv, row 50

File 1 file-level summary

File 1 chunk-level summary

File 1 chunk-level summary

Fearing the wrath of Hurricane Rita, staff at Memorial Hermann Baptist Hospital in Orange, Texas, hurriedly evacuated patients to a hospital's affiliate in Beaumont, Texas.

Source: fema-case-studies.csv, row 821

File 1 chunk-level summary

File 1 chunk-level summary

File Sources:

fema-case-studies.csv, row 50
fema-case-studies.csv, row 148
fema-case-studies.csv, row 681
fema-case-studies.csv, row 1184
fema-case-studies.csv, row 1185
fema-case-studies.csv, row 814
fema-case-studies.csv, row 821
fema-case-studies.csv, row 1099
fema-case-studies.csv, row 1235

Reference for File 1

Step 3 Collection

The screenshot displays the 'Step 3 Collection' interface, which is divided into two main panels. The left panel shows search results for 'fema-case-studies.csv', with a 'Matched Context: flood' and a 'Matched Context: residential' section. The right panel shows the 'Current Collection' with three items. A red dashed box highlights the 'Search Result' section on the left, and a red arrow points from it to the 'Current Collection' on the right. A green dashed box highlights the 'Other results added' section on the right, and a red dashed box highlights the 'The Search Result is now added to collection' section on the right.

Matched Context: flood

ADD TO COLLECTION

- Hurricane Ike struck Galveston, TX, on September 13, 2008.
- The storm affected 70-80% of residential structures in the city.
- FEMA provided local officials with assistance in home inspection.

Row 681 at fema-case-studies.csv

SHOW RAW TEXT

Possibly Matched Hazard and Certification

Matched Context: residential

ADD TO COLLECTION

- Memorial Hermann Baptist Hospital in Orange, TX evacuated patients to Beaumont, Texas due to Hurricane Rita.
- The evacuation was timely, as the hurricane posed significant threats to the area.

Row 821 at fema-case-studies.csv

SHOW RAW TEXT

Possibly Matched Hazard and Certification

Matched Context: flood

REMOVE FROM COLLECTION

Search Result

NEXT STEP (STEP4)

Current Collection

fema-case-studies.csv - Row 1235 **Other results added**

- The University of Texas MD Anderson Cancer Center in Houston has ranked among the top two cancer care hospitals in the U.S. for 25 years.
- This recognition is based on a survey by U.S. News & World Report.
- The context is related to Harris County, Texas, and the challenges posed by hurricanes in the region.

REMOVE FROM COLLECTION

fema-case-studies.csv - Row 1099

- Hurricane Ike struck Houston in September 2008 as a Category 2 storm, with wind gusts near 100 mph, causing significant damage.
- The storm resulted in downed power lines, blown-out windows, and extensive debris throughout the city.

Matched Context: mountain

REMOVE FROM COLLECTION

The Search Result is now added to collection

fema-case-studies.csv - Row 821

- Memorial Hermann Baptist Hospital in Orange, TX evacuated patients to Beaumont, Texas due to Hurricane Rita.
- The evacuation was timely, as the hurricane posed significant threats to the area.

Matched Context: flood

REMOVE FROM COLLECTION

Save your search and,
Prepare for later documentation

Step 4 Documentation

Hazards & Frequencies

Location: **Harris, TX**

Hurricane's Likelihood

Reason for this risk

Flood's Likelihood

Reason for this risk

Risk Matrix

☒ Show Selected Only

Sort By:

Hazard	System	Score
Hurricane	Architectural Systems	C
Severe Storm	Architectural Systems	C
Severe Ice Storm	Architectural Systems	C
Severe Storm	Architectural Systems	E
Severe Storm	Architectural Systems	F
Hurricane	Architectural Systems	F
Severe Storm	Architectural Systems	F
Severe Ice Storm	Architectural Systems	F
Hurricane	Architectural Systems	F
Severe Storm	Architectural Systems	V
Flood	Architectural Systems	V
Hurricane	Architectural Systems	V

Resources & Summaries

[SUMMARIZE SELECTED ITEMS](#)

Case Study

fema-case-studies.csv - Row 1235

- The University of Texas MD Anderson Cancer Center in Houston has ranked among the top two cancer care hospitals in the U.S. for 25 years.
- This recognition is based on a survey by U.S. News & World Report.
- The context is related to Harris County, Texas, and the challenges posed by hurricanes in the region.

☐ summarySelected ☐ addToReport

fema-case-studies.csv - Row 1099

- Hurricane Ike struck Houston in September 2008 as a Category 2 storm, with wind gusts near 100 mph, causing significant damage.
- The storm resulted in downed power lines, blown-out windows, and extensive debris throughout the city.

Matched Context: mountain

☐ summarySelected ☐ addToReport

fema-case-studies.csv - Row 821

- Memorial Hermann Baptist Hospital in Orange, TX evacuated patients to Beaumont, Texas due to Hurricane Rita.
- The evacuation was timely, as the hurricane posed significant threats to the area.

Matched Context: flood

☐ summarySelected ☐ addToReport

Strategy

Other Resource

the results just added in "collection"

Technology

Framework:

Frontend: [React.js](#), Backend: [Node.js](#),

Information Retrieval:

LangChain (RAG) , gpt 4-mini (OpenAI),

Visualization:

Three, react-force-graph-3d, etc.

UI:

Material UI

Technology

User's Question &
Expected Response

User Journey

*Which hazards are there in this area?
Will there be more in the future?
Give me some reliable source website, and
reliable hazard report.*

*Which project has similar context?
What can I learn from this precedent?*

What are some strategies for this context?

*How does these strategies
compared with others?*

User enter location, get related
hazard data and link to report

User would use Context Builder
to enter project info: location,
hazard, project type, etc.

User can also upload their data
choose the parser, and select
specific parse method.

User can manage file and
context within groups.

User can ask for any prece-
dents project strategies listed
and under similar context.

Then, user can use the viewer
to see how various potential
strategies address hazards or
comply with design principles

Technology

User's Question &
Expected Response

*Which hazards are there in this area?
Will there be more in the future?
Give me some reliable source website, and
reliable hazard report.*

*Which project has similar context?
What can I learn from this precedent?*

What are some strategies for this context?

*How does these strategies
compared with others?*

User Journey

User enter location, get related
hazard data and link to report

User would use Context Builder
to enter project info: location,
hazard, project type, etc.

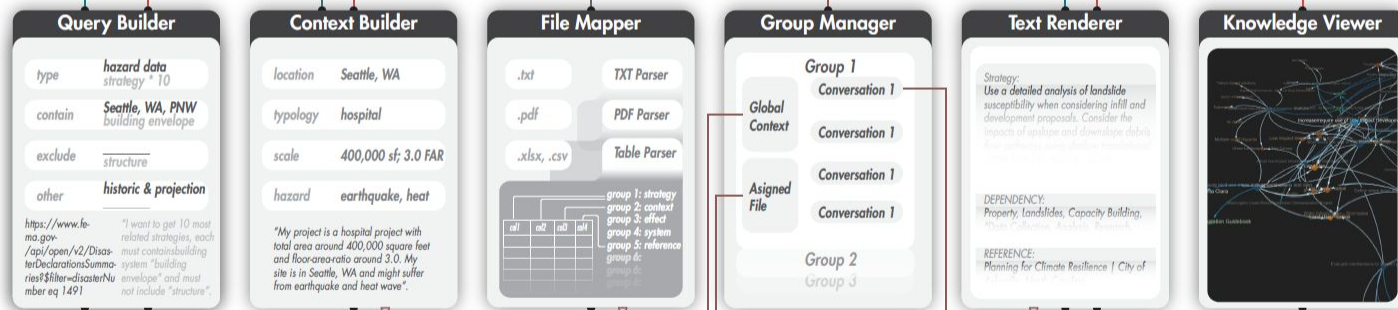
User can also upload their data
choose the parser, and select
specific parse method.

User can manage file and
context within groups.

User can ask for any prece-
dents project strategies listed
and under similar context.

Then, user can use the viewer
to see how various potential
strategies address hazards or
comply with design principles

Tool Interface Component



Frontend Data

Api endpoint from
FEMA, CDC, ect.

Query + Context
Integrated Prompt

Retrieved chunks

Backend

result
Response from api

query result
General Database

upload query result
User File Database

Integration

“One goal of **building integration**, therefore, is to **reduce the amount of time, material, and space employed in a building** while **increasing the number of activities that can take place within it**. The result is a balance. The task is to abstract the notion of building systems integration with the purpose of achieving the goal.” (*Building Systems Integration Handbook* 317).

The Building Systems Integration Handbook. Edited by Richard D. Rush, American Institute of Architects, 1986.

“One goal of **workflow integration**, therefore, is to **reduce the amount of time, resource, and cognitive load employed in a each task** while **increasing the depth of existing knowledge that can construct a new solution**.

Yongqin Zhao, 2025

Contribution

For Design Team

- Streamline resilience workflow, from 1-day Googling to 30-min exploration
- Get concrete examples at early phase, show client, set alignment on resilience

For Industry and Academia

- **End-to-end application of LLM in production**, not just a script in IDE
- Existing building resilience research mainly focus on *“how to bring TASK_A to next-level”*. **This research is about *“how to make everyone accessible to TASK_A”***

For Firm

- **For mid-large firm: A truly accessible Knowledge Sharing library** (as long as resilience champion maintain the knowledge, and DT maintain the tech).
- **For small firm: Easy access to data** (assuming this would get support from industry leaders and researcher)

Limitation

Data Source

- **Step 1 Hazard Data: Only US (some mentioned CA). Only historic (no future projection)**
- **Step 2 Automation: still need to manually fill out hazard's impact on system**
- **Step 3 Resource: Only Demo data**

Technology

- **Only Table file (csv) and PDF. Image is not currently supported**
- **Naive RAG, and not as good as SOTA RAG (like GraphRAG)**
- **Cheap LLM (GPT-4 mini)**
- **Context Matching is based on keywords matching. Not dynamic**

Further Development

Support from industry organizations, institution, and leading firms is needed

- **I want to maintain this project, but would need support on the knowledge side**

Support from Tech and Infrastructure

- **LLM**
- **Hosting**

Developing is Fun (?)

Code

-> Bug -> Code -> Bug -> Code

