

# Mobile Application Handbook Version 2.0

# Released November 15, 2023

Authored by: Mohammad Alam, University of Notre Dame, StEER Research Associate

In Collaboration with:

Tracy Kijewski-Correa, University of Notre Dame, StEER Director Khalid Mosalam, University of California, Berkeley, StEER Associate Director for Seismic Hazards David O. Prevatt, University of Florida, Associate Director for Wind Hazards Ian Robertson, University of Hawai'i at Manoa, Associate Director for Coastal Hazards

David Roueche, Auburn University, Associate Director for Data Standards



# PREFACE

The National Science Foundation (NSF) awarded an EAGER grant (CMMI 1841667) to a consortium of universities to form the Structural Extreme Events Reconnaissance (StEER) Network (see https://www.steer.network for more details). StEER was renewed through a second award (CMMI 2103550) to further enhance its operational model and develop new capabilities for more efficient and impactful post-event reconnaissance. StEER builds societal resilience by generating new knowledge on the performance of the built environment through impactful post-disaster reconnaissance disseminated to affected communities. StEER achieves this vision by: (1) deepening structural engineers' capacity for post-event reconnaissance by promoting community-driven standards, best practices, and training, as well as their understanding of the effect of natural hazards on society; (2) coordination leveraging its distributed network of members and partners for early, efficient and impactful responses to disasters; and (3) collaboration that broadly engages communities of research, practice and policy to accelerate learning from disasters.

Under the banner of the Natural Hazards Engineering Research Infrastructure (NHERI) CONVERGE node, StEER works closely with the wider Extreme Events Reconnaissance consortium to promote interdisciplinary disaster reconnaissance and research. The consortium includes the Geotechnical Extreme Events Reconnaissance (GEER) Association and the networks for Interdisciplinary Science and Engineering Extreme Events Research (ISEEER), Nearshore Extreme Event Reconnaissance (NEER), Operations and Systems Engineering Extreme Events Research (OSEEER), Social Science Extreme Events Research (SSEER), Sustainable Material Management Extreme Events Reconnaissance (SUMMEER), and Public Health Extreme Events Research (PHEER), as well as the NHERI RAPID equipment facility, the NHERI Network Coordination Office (NCO), and NHERI DesignSafe CI, curation site for all StEER products.

While the StEER network currently consists of the three primary nodes located at the University of Notre Dame (Coordinating Node), University of Florida (Southeast Regional Node), and University of California, Berkeley (Pacific Regional Node), StEER is currently expanding its network of regional nodes worldwide to enable swift and high quality responses to major disasters globally.

StEER's founding organizational structure includes a governance layer comprised of core leadership with Associate Directors for each of the primary hazards as well as cross-cutting areas of Assessment Technologies and Data Standards, led by the following individuals:

- **Tracy Kijewski-Correa (PI)**, University of Notre Dame, serves as StEER Director responsible for overseeing the design and operationalization of the network and representing StEER in the NHERI Converge Leadership Corps.
- Khalid Mosalam (co-PI), University of California, Berkeley, serves as StEER Associate Director for Seismic Hazards, serving as primary liaison to the Earthquake Engineering community.
- **David O. Prevatt (co-PI)**, University of Florida, serves as StEER Associate Director for Wind Hazards, serving as primary liaison to the Wind Engineering community.
- **Ian Robertson (co-PI)**, University of Hawai'i at Manoa, serves as StEER Associate Director for Coastal Hazards, serving as a primary liaison to the coastal engineering community and ensuring a robust capacity for multi-hazard assessments.
- **David Roueche (co-PI)**, Auburn University, serves as StEER Associate Director for Data Standards, ensuring StEER processes deliver reliable and standardized reconnaissance data suitable for re-use by the community.

This core leadership team works closely with StEER Research Associates, Data Librarians and its Student Administrator in event responses, in consultation with its Advisory Boards for Coastal, Seismic and Wind Hazards.



# **DOCUMENT SCOPE & ACKNOWLEDGEMENTS**

This document assembles guidance and instructions to support users of StEER's mobile apps. The primary user base is StEER members participating in Field Assessment Structural Teams (FASTs); this guidance should be at minimum reviewed by all Level 2, 3 or 4 StEER members eligible to deploy to conduct field assessments. This guidance document introduces the StEER Unified App, an app developed to collect standardized post-disaster hazard and performance assessment data and metadata following earthquake, windstorm, and coastal events. Emphasis is placed on core functionalities and required fields of the app; Appendices provide additional information and guidance on observations that are field priorities. In addition to this document, StEER will be releasing videos to assist in training users on these apps. These will be available at <a href="https://www.steer.network/resources">https://www.steer.network/resources</a>. StEER has also created a **Mobile App Quick Reference Sheet (QRS)** available at this same website to summarize the key aspects of this guidance document.

StEER is indebted to the open platform and support provided by <u>Fulcrum (Spatial Networks)</u>, which is the primary data acquisition framework for its performance assessments. StEER also acknowledges a number of organizations and assessment frameworks that were consulted in the design of StEER's assessments. These include the Earthquake Engineering Research Institute (EERI), Applied Technology Council (ATC), Ministry of Business, Innovation, and Employment (MBIE) in New Zealand, Earthquake Engineering Field Investigation Team (EEFIT), and British Columbia (BC) Housing. The apps further benefited from the insights exchanged at the StEER Cross-Hazard Planning Workshop on January 18, 2020. StEER is particularly indebted to the StEER members and friends of StEER who attended this workshop to guide the assessment framework and the field priorities for structural performance assessments.

Finally, StEER wishes to further acknowledge that these apps operate within a wider body of policies, inspired greatly by the example of Geotechnical Extreme Events Reconnaissance (GEER) Association and the opportunities to exchange ideas and best practices among the members of the Natural Hazard Engineering Research Infrastructure (NHERI) Converge Leadership Corps.



This material is based upon work supported by the National Science Foundation under Grant No. CMMI 1841667 and 2103550. Any opinions, findings, and conclusions or recommendations expressed in this material are those of StEER and do not necessarily reflect the views of the National Science Foundation.

#### TABLE OF CONTENTS



PREFACE	2
DOCUMENT SCOPE & ACKNOWLEDGEMENTS	-
ABBREVIATIONS	5
BACKGROUND	8
GETTING STARTED WITH FULCRUM APP	9
BASIC FUNCTIONALITIES WITHIN FULCRUM	9
Using the StEER Fulcrum Apps	10
Geolocating Records	12
Adding Layers	12
STEER ASSESSMENT FRAMEWORK	13
1.0 App Selection Required Fields	15
2.0 General Information Required Fields	18
3.0 Supplemental Media Required Fields	20
4.0 Survey Classes	21
4a. Hazard Survey	21
4b. Performance Assessment Survey	27
4b.1 Facility Information Required Fields	27
4b.2. Performance Information Required Fields	30
4b.3 Functionality Information Required Fields	33
5.0 Record Update Tracking	34
Appendices	35
Appendix A. Orientation to the Fulcrum Web Interface	35
Appendix B. Tiered Performance Assessment	38
Appendix C. Field Priorities	39
Appendix C.1 App Selection Field Priorities	39
Appendix C.2 General Information Field Priorities	39
Appendix C.3 Supplemental Media Field Priorities	39
Appendix C.4a.1 Earthquake Hazard Information Field Priorities	39
Appendix C.4a.2 Windstorm Hazard Information Field Priorities	39
Appendix C.4a.3 Coastal Hazard Information Field Priorities	39
Appendix C.4b.1 Facility Information Field Priorities	40
Appendix C.4b.2 Performance Information Field Priorities	43
Appendix C.4b.3 Functionality Information Field Priorities	45
Appendix C.5 Record Update Tracking	46



# ABBREVIATIONS

Acronym	General Terms	Brief Description
	DesignSafe	Data Repository
	DesignSafe-Cl	Academic Organization within NHERI
ASCE	American Society of Civil Engineers	Professional Organization
ASTM	American Society for Testing and Materials (now ASTM International)	Standards Body
ATC	Applied Technology Council	Professional Organization
BOCA	Building Officials and Code Administrators	Code Body
CC-BY	Creative Commons Attribution License	Code/Standard
CESMD	Center for Engineering Strong Motion Data	Governmental Agency
CFE	Comision Federal de Electricidad = Federal Electricity Commission [in English].	State owned electricity utility in Mexico
CI	Cyberinfrastructure	Research Asset
CLPE	Critical Load Path Elements	StEER Term
CMU	Concrete Masonry Unit	Building Material
CONAGUA	National Water Commission [English translation]	Mexican Government Agency
DBE	Design Basis Earthquake	Design Terminology
DEQC	Data Enrichment and Quality Control	StEER Term
DIF	National Integral Family Development System	Mexican Agency
DOI	Digital Object Identifier	Common Term
EARR	Early Access Reconnaissance Report	StEER Term
EERI	Earthquake Engineering Research Institute	Professional Organization
EEFIT	Earthquake Engineering Field Investigation Team	Professional Organization
EF	Enhanced Fujita Scale	Hazard Intensity Scale
EF	Equipment Facility	Academic Organization within NHERI
EIFS	Exterior Insulation Finish System	Building Component
FAA	Federal Aviation Administration	Governmental Agency
FAQ	Frequently Asked Questions	Common Term
FAST	Field Assessment Structural Team	StEER Term



FEMA	Federal Emergency Management Agency	Governmental Agency
FIRM	Flood Insurance Rate Maps	Regulatory Product
GEER	Geotechnical Extreme Events Reconnaissance	Academic Organization within NHERI
GPS	Global Positioning System	Measurement Technology
GSA	Government Services Administration	Governmental Agency
HVAC	Heating, ventilation and air conditioning	Building System
HWM	High Water Mark	Intensity Measure
IBC	International Building Code	Code/Standard
ICC	International Code Council	Code Body
IFT	Federal Telecommunications Institute [English translation]	Mexican Government Agency
IRC	International Residential Code	Code/Standard
Interdisciplinary Science and Engineering Extreme ISEEER Events Research		Academic Organization within NHERI
Lidar	Light Detection and Ranging	Measurement Technology
MCE	Maximum Considered Earthquake Design Terminology	
ME&P	Mechanical, electrical and plumbing Building System	
MMI	Modified Mercalli Intensity	Hazard Intensity Scale
NBC	National Building Code Code/Standard	
NEER	Nearshore Extreme Event Reconnaissance	Academic Organization within NHERI
NFIP	National Flood Insurance Program	Government Program
NHERI	Natural Hazards Engineering Research Infrastructure	Academic Organization within NHERI
NIST	National Institute of Standards and Technology	Governmental Agency
NOAA	National Oceanic and Atmospheric Administration	Governmental Agency
NSF	National Science Foundation	Governmental Agency
NWS	National Weather Service	Governmental Agency
OSB	Oriented strand board	Construction Material
OSEEER	Operations and Systems Engineering Extreme Events Research	Academic Organization within NHERI
PEER	Pacific Earthquake Engineering Research center	Academic Organization (Earthquakes)
PGA	Peak Ground Acceleration	Intensity Measure



PHEER	Public Health Extreme Events Research	Academic Organization within NHERI
PVRR	Preliminary Virtual Reconnaissance Report	StEER Term
QC	Quality Control	Oversight process
RAPID	RAPID Grant	Funding Mechanism
RAPID-EF	RAPID Experimental Facility	Academic Organization within NHERI
RC	Reinforced Concrete	Building Material
SAR	Search and Rescue	Standard Hazards Terminology
SGI	Special Government Interest	FAA Process
SLP	Surface-Level Panoramas	Measurement Technology
SMS	Short Message Service	Communication Modality
SPC	Storm Prediction Center	Governmental Agency
SSEER	Social Science Extreme Events Research	Academic Organization within NHERI
StEER	Structural Extreme Events Reconnaissance network	Academic Organization within NHERI
SUMMEER	SUstainable Material Management Extreme Events Reconnaissance	Academic Organization within NHERI
TAS	Testing Application Standard	Technical Standard
UAS/V	Unmanned Aerial Survey/System/Vehicle	Measurement Technology
USD	US Dollar	Standard Currency
USGS	United States Geological Survey	Governmental Agency
VAST	Virtual Assessment Structural Team	StEER Term
WS	Windshield Survey	Measurement Technology



# BACKGROUND

StEER currently utilizes Fulcrum, a commercial form-builder and data collection platform produced by Spatial Networks Inc., for its performance assessments<sup>1</sup>. Fulcrum consists of both a mobile application, which must be downloaded from the Apple or Google Play app stores, and a web platform (<u>www.fulcrumapp.com</u>). Each user must install the Fulcrum app from the appropriate app store to access the StEER data collection forms in the field. After data has been collected via the mobile app and synced to the web platform, the data can be viewed, enriched, and downloaded through the web interface.

Within the Fulcrum application, users can create custom apps for the collection of geotagged records consisting of photographs, audio recordings, videos and associated fields encoded in the custom app. This type of structured assessment ensures a standardized, comprehensive, step-by-step process for documenting investigation parameters, attributes of the structure and/or hazard, and the impacts of the event on the structure and its surroundings.

StEER initially built out its performance assessment apps in Fulcrum based on hazard and/or structure type:

- StEER Building US (Windstorm): This app focuses on characterizing the post-storm condition of buildings, including their structural systems and envelope, following the impacts of windstorm-related hazards, including high winds, hurricane-induced storm surge/flooding and rainwater ingress.
- 2. **StEER Non-Building US (Windstorm):** This app focuses on characterizing the post-storm condition of non-building structures such as bridges, dams, and power infrastructure following the impacts of windstorm-related hazards, including high winds and hurricane-induced storm surge/flooding.
- 3. **StEER Earthquake App\_v2:** This app assesses the performance of buildings, bridges, and lifelines, while documenting associated evidence such as liquefaction and fault ruptures.
- 4. **StEER Coastal App\_v3:** This app focuses on hurricane surge and wave and tsunami damage to coastal structures, facilities and infrastructure. It is also designed for recording runup and inundation elevation measurements.

This led to a collection of custom apps all accessible within the Fulcrum mobile application. However, this handbook signals the transition to a single unified app in Fulcrum: **StEER Unified App\_v1** that enables users to assess all of StEER's supported hazards and their impacts on a wide range of buildings and other infrastructure in a single app, with nested menus that display appropriate fields within the app user interface based on the assessment type, hazard class,

<sup>&</sup>lt;sup>1</sup> StEER is also exploring migrating its assessment frameworks to the RApp, which is being developed by the NSF NHERI RAPID EF at the University of Washington, at a future date.



and structure type investigated. Legacy data from the original apps listed above will be migrated into the new unified app over time.

This handbook will guide users in setting up and configuring their Fulcrum App, before introducing the Unified Assessment App's structure and fields. Note that the interfaces for the Fulcrum app look slightly different in iOS vs. Android; screen captures for both platforms are provided for illustrative purposes.

# **GETTING STARTED WITH FULCRUM APP**

Users are requested to take the following steps once they are added to StEER's Fulcrum account. Please DO NOT wait until you deploy to the field to take these actions; rather do so at your earliest convenience upon receiving access to Fulcrum:

- 1. You will receive a notification email from Fulcrum once the StEER Administrator has added you to the platform. Complete the process outlined in that email to set up your Fulcrum account and access StEER's applications.
- Download and install the Fulcrum App on your mobile device (free from the Apple or Google Play app store) and log into your account using the credentials you created in Step 1. Familiarize yourself with the App and the features following instructions in the subsequent sections of this handbook.
  - a. When using the app in the field, always ensure the GPS on your phone is enabled.
  - b. Your phone may have precision settings: Turn on High Accuracy option that uses GPS, WiFi and Mobile for localization.
  - c. Override any settings on your phone that might shut down GPS tracking in low battery mode.

Note: The above recommendations ensure records generated in Fulcrum are properly geotagged. You should also familiarize yourself with the Fulcrum web-interface on your computer: <u>https://www.fulcrumapp.com/</u>. See <u>Appendix A</u> for basic instructions on accessing the Fulcrum web-interface.

## **BASIC FUNCTIONALITIES WITHIN FULCRUM**

Once the app is installed on your Apple or Android device, log into your account in Fulcrum. Once logged in, users should configure their Fulcrum app settings as instructed in **Table 1**.

These settings can be accessed through the menu labeled Settings with the gear symbol. These settings affect how and when data is synced from local storage on the smartphone to the cloud server, which is then accessible to other users either through the mobile or the web platform. If mobile connectivity is strong and the user has a large/unlimited data allowance, records and media can be synced as records are created. Otherwise, records can be synced without the media to conserve data, allowing team members to share in near real-time where



assessments have been conducted. <u>If no connectivity is present</u>, all data is stored locally on the <u>device and only synced once a reliable connection is obtained</u>. Confirm these settings periodically or whenever network connectivity changes. <u>Please note that the Native setting for photo quality is especially important to ensure images have the resolution necessary for processing</u>.

Network Connectivity	Strong Connectivity		Limited Connectivity
Mobile Data Access	Limited Data Plan	Limited Data Plan Unlimited Data Plan	
	Options and Reco	mmended Settings	
Auto-Sync after Launch	On	On	On
Auto-Sync Record Edits	o-Sync Record On On ts		Off
Sync Settings: Photos	WiFi Only	Always	WiFi Only
Sync Settings: Videos	WiFi Only WiFi Only		WiFi Only
Sync Settings: Audio	WiFi Only WiFi Only		WiFi Only
Photo Quality	Native		
Save to Camera Roll/Gallery	On		

Table 1. Recommended Settings in Fulcrum for use in the field

## Using the StEER Fulcrum Apps

Users will see a symbol that looks like a circular pair of arrows in the Fulcrum App. Click these circular arrows (at any time) to synchronize your app with the Fulcrum cloud database. The synchronization process will sync any records you have created since last sync in your device to the cloud database as well as download new records created by others and updates made to the apps that you have access to in your StEER Fulcrum account. The arrows will spin while synchronization is taking place. The arrows will stop spinning when synchronizing is complete.

From the Home menu in the app, users can tap the Apps menu to access all the custom apps available to their users account (Figure 1). Apps are displayed as a list (and holding down



on any app in the list allows you to add it to your Favorites). To access/use an app, click on the name of the app. Note: the unified app will be used for all new data collection; legacy apps will continue to display to preserve data access but will eventually phase out once their data is migrated into the new unified app format.

The existing records created in any app can be viewed in one of two ways:

- 1. List View 🗐: list sorted by date updated or
- 2. **Map View** : a map view showing the geolocated points.

The icons to access these two views are shown at the bottom of iOS apps and top of Android

apps. In either view, a new record is created by pressing the + icon or by long-pressing on a location in the map view. Performing either of these two actions opens the assessment form. Clicking on Save in the upper right corner of the app screen will save the record.



Figure 1. Accessing the StEER apps within the Fulcrum app: (a) Android and (b) iOS.

StEER designed its apps to provide a standardized, step-by-step process for capturing post-disaster data and metadata. The app consists of a series of high-level sections and drill-down subsections for detailed assessments, with numeric, text, single-choice, and multiple-choice fields, as well as media attachments within each section. Throughout the app, guidance is provided by means of field titles and text labels above fields. Clicking on the **More Information** icon launches a pop-up with additional explanations. More details on app features are discussed in different sections of the <u>StEER Assessment App Framework</u>.

Imagery is perhaps the most vital data collected in the field. Photographs can be captured in Fulcrum by one of two ways:

1. <u>Method 1</u>: Press the camera icon is within the Fulcrum app to activate the phone's camera and take a photo within the Fulcrum app.



2. <u>Method 2</u>: Upload a previously-taken photograph (stored on the mobile device) to Fulcrum. Note that photos can only be uploaded one at a time.

Other media (audio recordings for dictation, video clips) follow a similar dual methodology for creation or attachment.

## **Geolocating Records**

Records should always be geolocated using the Locate icon  $\textcircled$  so that they are centered on the object being assessed. This is accomplished by tapping the crosshairs icon while logging a new assessment or editing an existing assessment. Tapping the crosshairs icon brings up a map with a crosshair on it. Scroll the map until the crosshair is centered over the location of the structure being assessed as shown in Figure 2. Correctly geolocating the record improves the accuracy of the built-in geocoding in Fulcrum (automatically converting GPS coordinates to a postal address, when possible), since geocoding is performed based on the location of the record. The geocoded address should be confirmed using any visible building numbers and street signs and corrected as needed.



**Figure 2.** Manually set the record location when logging a new assessment using the crosshairs in Android (left) or iOS (middle) versions, centering the red marker (right) on the building or other point of interest being assessed, rather than at the location adjacent to the building where the surveyor was standing when creating the record.

## Adding Layers

Within the Fulcrum app, layers 🗐 can be enabled to overlay external data sources such as aerial maps, polygons, or points. This process is illustrated for iOS and Android systems in Figure 3. StEER uses this feature to provide layers such as post-disaster aerial imagery, parcel



data communicating building inventory features, and points/transects/polygons respectively indicating structures/routes/areas to be assessed. These layers are pre-loaded by StEER into member profiles for ready access using their mobile app.



Figure 3. Views in Android (top) and iOS (bottom) for importing layers into the Fulcrum App.

## STEER ASSESSMENT FRAMEWORK

StEER's unified app in Fulcrum is presently structured to enable a unified performance assessment of structures across hazards (earthquake, windstorm, and coastal) and structure



classes at varying levels of rigor through a single unified app. Table 2 illustrates the overall app structure with a brief description of the purpose of each section of the app. These apps intelligently present the user with the necessary fields and guidance based on the selected survey type, the hazard, and the structure class. As a result, select fields indicated by red asterisks (\*) are **Required Fields (RF)** that must be completed since their responses are used by the conditional logic in the app to display subsequent fields in later sections of the app.

FAST members are normally focused on **Performance Assessments** of buildings and other structures; the unified app supports three increasingly more rigorous levels of assessment:

- Basic Assessment (BA) that includes high-level global damage assessment;
- Load Path Assessment (LPA) that includes in-depth performance assessment of Critical Load Path Elements (CLPE) including identification of geolocation of damaged elements, damage measures/modes, component damage ratings, etc.;
- **Detailed Component Assessment (DCA)** that involves collecting detailed information on components, including dimensional data and/or material properties, as well as hazard intensity measures.

Only the Basic Assessment (BA) is currently enabled for all hazard and building classes; LPA and DCA fields will be enabled in the near future. See <u>Appendix B</u> for additional details on these three tiers of Performance Assessments.

Since these Performance Assessments are comprehensive and rigorous, it is not feasible for FAST to complete every field while on site. Thus the app is sequenced to prioritize the following actions:

- 1. capturing clear photographs of the site and structure from multiple perspectives;
- 2. accurately geolocating the assessment;

and then <u>populating fields that would only be discernible through on-site forensic investigation</u> -termed a **Field Priority (FP).** FP fields have "(Field Priority)" displayed next to their heading. Users are encouraged to also note any unusual or unique characteristics of the structure that would affect its performance under the given hazard and capture those through available free form notes fields and additional photographs.

The following subsections provide a description of each section of the app, with a table describing the **Required Fields (RFs)** for that section of the app. Appendices associated with each section of the app (<u>Appendix C</u>) list the **Field Priorities (FPs)** to be documented while on site. Screenshots from the basic assessment of a building for earthquake hazard are provided throughout for illustration, though the framework in Table 2 is similarly adopted for windstorm and coastal hazards. Note that the screenshots that follow are from an Apple device; Android versions will display slightly differently.

 Table 2. Organization of StEER's customized app for unified performance assessment

1.0	App Selection	Desired survey and assessment type, based on hazard &



		structure.
2.0	General Information	Survey parameters, spatial data.
3.0	Supplemental Media Media on structure, site.	
4.0	Survey Classes	(adapts based on choices in App Selection)
	4a. Hazard Survey	Select to document evidence of hazard intensity.
	4a.1 Earthquake Hazard Information	Earthquake source mechanism (magnitude, depth, location), recorded and qualitative shaking information at the site, and other secondary effects.
	4a.2 Windstorm Hazard Information Windstorm metadata, hazard intensity indicators including trees, towers, signposts metadata and damage observation	
	4a.3 Coastal Hazard Information	Flow condition measurement at site including high water mark (HWM), runup, flow velocity, wave condition.
	4b. Performance Assessment Survey	Select to document evidence of hazard impacts to built environment.
	4b.1 Facility Information	Basic structure information, typology.
	4b.2 Performance Information	(adapts based on choices in App Selection)
	Basic Assessment (BA)	Photo documentation, overall conditions, global performance rating.
	Load Path Assessment (LPA)	Documentation and evaluation of critical load path elements.
	Direct Component Assessment (DCA)	Detailed component information, dimensional data, specifications.
	4b.3 Functionality Information	Documents functional recovery/recovery state.
5.0	Record Update Tracking	Notes on quality control, record updating.

**TIP:** If you are a first time Fulcrum user, login and submit a few "dummy" assessments before going into the field so that you are comfortable with the workflow of the app. Direct message David Roueche, the Associate Director for Data Standards, on Slack to review the "dummy" assessments before going into the field to ensure proper use of the Fulcrum App.

## **1.0 App Selection Required Fields**

The App Selection section of the app contains several required fields necessary to specify which fields should be presented in subsequent sections of the app. Table 1.1 describes the required fields (RF) in this section of the app. See Figure 1.1 for screen captures of this section of the app.



Table 1.1. Explanation of Required Fields in Section 1: App Selection			
Field Name	Choice Choice List Description		
Reconnaissance Level	Single choice	<ol> <li>StEER VAST</li> <li>StEER FAST</li> <li>Other</li> </ol>	Distinguishes if record is affiliated with StEER response modality: in the field (FAST) or virtually (VAST).
Survey Category	Single choice	<ol> <li>Hazard Survey</li> <li>Performance Assessment Survey</li> </ol>	Selects type of survey to be presented in Section 4 of the App.
Primary Hazard Category	Single choice	<ol> <li>Earthquake</li> <li>Windstorm</li> <li>Coastal</li> </ol>	Selects primary hazard class to be presented in the App; Windstorm includes hurricanes and tornadoes; Coastal includes storm surge and tsunami.
Cascading Hazard Category	Single choice	<ol> <li>None</li> <li>Tsunami</li> <li>Rain/Flooding</li> <li>Wind Effect</li> </ol>	Cascading hazard associated with the primary hazard. For example, a tsunami may follow an earthquake; rain/flooding may be accompanied with a tornado, and coastal surge and wave may accompany wind during a hurricane.
Performance Assessment Category	Single choice	<ol> <li>Basic Assessment (BA)</li> <li>Load Path Assessment (LPA)</li> <li>Detailed Component Assessment (DCA)</li> </ol>	Indicates rigor of assessment and specifies the fields presented later in app.
Facility Category	Single choice	<ol> <li>Buildings</li> <li>Bridges</li> <li>Power Infrastructure</li> <li>Water System</li> <li>Wastewater System</li> <li>Liquid Fuel System</li> <li>Communication System</li> <li>Port and Harbor</li> <li>Coastal Protective Structures</li> <li>Other</li> </ol>	Selects type of structure to be assessed and specifies the fields presented later in the app.
Inspection Type	Single choice	<ol> <li>Structural</li> <li>Structural and Nonstructural Both</li> </ol>	Specifies the fields presented later in the app depending on whether structural and/or non-structural [1] elements are assessed



mechanical/electrical/plumbing (MEP) systems, contents, etc.

Cancel StEER Earthquake A Save	Cancel Survey Category Done all T-Mobile Wi 🕈 9:02 AM	<b>4</b> 89% 🛤
Damage state: None	Q Search Cancel StEER Unified App. 2 Reference Files	_v1 Save
Turkey - kahramanmake Sequence (2023)	Hazard Survey	
	Performance Assessment Survey StEER FAST	
I agree that data submitted through this form will be publicly available on StEER	Survey Category Performance Assessment Survey	• i) vey
Red * indicates that the user must respond to this field	Clear Value Primary Hazard Category Earthquake	•
App Selection	Cascading Hazard Cat Done Cascading Hazard Category None	•
Reconnaissance Level	Earthquake Performance Assessment Catego Basic Assessment (BA)	ory *
Survey Category *	Windstorm Facility Category Buildings	•
Primary Hazard Category	Coastal Inspection Type Structural	• (i)
Report Locate Delete	Clear Value	<b>†</b> ate

**Figure 1.1.** Snapshot in iOS of "App Selection" section in StEER Unified App. (Left) Multiple app selection fields each with several options for selection; (Middle) Example choices for Reconnaissance Level and Survey Category; and (Right) An example of completed "App Selection" section.



## 2.0 General Information Required Fields

The General Information section of the app involves gathering information related to the inspector, facility geolocation, sampling approach, and inspection method. Required fields in this section of the app are listed in Table 2.1; additional field priority observations are detailed in <u>Appendix C.2</u>.

Table 2.1. Explanation of Required Fields in Section 2: General Information			
Field Name	Choice	Choice List	Description
Sampling Method	Single choice	<ol> <li>statistical sampling</li> <li>critical case sampling</li> <li>cluster-based sampling</li> <li>transect-based sampling</li> <li>quota-based sampling</li> <li>opportunistic sampling</li> </ol>	Sampling method used to select the structure, based on the standard sampling methods used by StEER (normally communicated in FAST Pre-Deployment Briefing).
Area Assessed	Single choice	<ol> <li>Exterior</li> <li>Exterior and Interior Both</li> </ol>	Specify if the assessor was able to access the building exterior or exterior and interior both.
Elevation Assessed	Multiple choice	<ol> <li>None</li> <li>Front</li> <li>Right</li> <li>Back</li> <li>Left</li> <li>Roof</li> <li>All</li> <li>Other</li> </ol>	Specify which of the structural elevation the assessor was able to assess, e.g., different sides, or top of the structure.

One important Required Field in this section is the Sampling Method. Users should specify the sampling method used to select the structure, based on the standard sampling methods used by StEER (the recommended sampling method is normally communicated in the FAST Pre-Deployment Briefing). These sampling methods include:

- *statistical sampling* where every N-th building in a cluster or along a route is sampled for performance assessment;
- *critical case sampling* selects buildings that meet specific criteria, e.g., instrumented or has targeted performance characteristics;
- *cluster-based sampling* where buildings within a defined radius of point are sampled, e.g. within X meters of a ground motion station;



## Mobile Application Handbook

Building Resilience through Reconnaissance Version 2.0 | Released November 15, 2023

- *transect-based sampling* that involves sampling buildings along a path that moves across the hazard intensity gradient;
- **quota-based sampling** that involves sampling buildings to achieve a representative sample based on characteristics of underlying building inventory; and
- **opportunistic sampling** which involves assessment of structure not included in initial sampling strategy, based upon unique features or performance observed in the field.

Note that a description of these sampling methods can be accessed through the info pop-up (accessed by encircled "i" icon () on that field of the App), as shown in Figure 2.1.

K Back General Information			Description Done
2 Reference Files			Sampling Method
Date of Inspection September 23, 2023	i		<ol> <li>Statistical Sample: Sampling every Nth building in a cluster or along a route for performance assessment.</li> </ol>
Time of Inspection 9:01 AM	(i)		2. Critical Case Sampling: Critical Case Sampling.
Facility Address (Field Priority)	i		<ol> <li>Cluster-Based Sampling: Sampling buildings within a defined radius of a point, e.g., ground motion station.</li> </ol>
		1	<ol> <li>Transect-Based Sampling: Sampling buildings along a path that moves across</li> </ol>
Contact Information of Facility Owner			the hazard intensity gradient.
		1	5. Quota-Based Sampling: Sampling buildings to achieve a representative
Sampling Method	*		sample based on characteristics of underlying building inventory.
Area Assessed	•		<ol> <li>Opportunistic Sampling: Assessment of structure not included in initial sampling strategy, based upon unique features or</li> </ol>
Elevation Assessed	• (i)		performance observed in the field.

**Figure 2.1.** Screenshot in iOS of "General Information" section in StEER Unified App. Note the information button (Information button Information) can be used for additional explanation/description of fields that are deemed not self-explanatory and necessary to guide field investigators.



## 3.0 Supplemental Media Required Fields

The Supplemental Media Attachment section collects information on the surroundings of the assessed structure or hazard survey site using a range of media, <u>before focusing on the structure/hazard site itself</u>. Table 3.1 lists the required fields for this section of the app; additional field priority observations are detailed in <u>Appendix C.3</u>. See Figure 3.1 for screenshots of the supplemental media collection interface.

Table 3.1. Explanation of Required Fields in Section 3: Supplemental Media		
Field Name	Description	
Photos	Sequence of photos taken to provide perspective of the surroundings of structure/site under investigation. Photos should be taken in counterclockwise sequence (front, right, back, left) facing away from the structure being investigated.	



**Figure 3.1.** Screenshot of 'Supplementary Media Attachment' section. Herein different media including photos, videos, audio dictations are used to collect information on the surroundings of the assessed structure or hazard survey site.



The following convention is recommended for visual evidence gathering, illustrated using a building. For each wall, turn your back to the wall, take a photo looking away from the building to capture the conditions of the surroundings:

- Start by looking at the front of the building. This is wall 1.
- Then walk counterclockwise to the right side wall. This is wall 2.
- Continue to walk to the rear. This is wall 3.
- Continue to walk to the other side. This is wall 4.

You can even reference this numbering in the caption of any image you acquire on the App. You may also choose to create numbered placards to include in the photos instead of labeling via caption.

When collecting this imagery, take pictures of any evidence of damage to the ground beneath or next to the building, noting the side number (caption field or placard in image). See Figure 3.1 for guidance embedded in the info pop-up (accessed by **More Information** icon on that field of the App). *Note: if surface-level panoramas were captured around the same time as the on-site performance assessments (as is common practice in Level 2 response preceding the deployment of field teams in Level 3), focus the site documentation on the finer scale features near the structure that may not be visible from a vehicle-mounted camera from the street.* 

## 4.0 Survey Classes

The Survey Classes section collects information on either related to hazard intensity information under 'Hazard Survey' or hazards impact on the built-environment documented under the 'Performance Assessment Survey'.

## 4a. Hazard Survey

This section of the app is used when the assessment focuses on the hazards intensity observed in a given event. Brief details of each of the hazard information data collection is presented below.

#### 4a.1 Earthquake Hazard Information

Under this section information is collected related to general information such as earthquake source mechanism (magnitude, depth, location), recorded and qualitative shaking information, and primary and secondary hazard effect observed at the site. Table 4a.1 lists all the required fields that need to be documented in this section. See Figure 4a.1 for screenshots of the earthquake hazard information collection interface.



Table 4a.1. Explanation of Required Fields in Section 4a.1: Earthquake Hazard Information			
Field Name	Choice	Choice List	Description
Assessed Earthquake Hazards	Multiple Choice	<ul> <li>Ground Shaking</li> <li>Landslide</li> <li>Liquefaction</li> <li>Lateral spreading</li> <li>Surface faulting</li> <li>None</li> <li>Other</li> </ul>	Selects all the primary hazards that can be observed in the earthquake affected site under investigation.
Secondary Earthquake Hazards Present	Multiple Choice	<ul> <li>Fire (gas leak)</li> <li>Flooding</li> <li>Hazardous materials</li> <li>None</li> <li>Other</li> </ul>	Lists cascading/secondary hazard following the earthquake observed at the site.



**Figure 4a.1.** Snapshot in iOS of "Earthquake Hazard Information " section in StEER Unified App. (Left) subsections recording general earthquake information and specific shaking intensity; (Middle) ground motion parameters recorded near the site; and (Right) RFs choices for assessed primary and secondary earthquake hazard effects.



#### 4a.2 Windstorm Hazard Information

Under this section information is gathered on windstorm intensity surrogate objects including trees, towers, signposts metadata, damage state and damage distribution observations. Table 4a.2 lists all the required fields of the Windstorm Hazard Information section. Figure 4a.2 shows example screenshots of windstorm hazard indicator information collection interface.

Table 4a.2. Explanation of Required Fields in Section 4a.2: Windstorm Hazard Information			
Field Name	Choice	Choice List	Description
Windstorm Hazard Indicators	Multiple Choice	<ul><li>Tree</li><li>Tower</li><li>Sign</li></ul>	Selects all the windstorm hazard intensity indicators.
Tree Damage State	Single Choice	<ul> <li>Undamaged</li> <li>Small branches torn off</li> <li>Large branches torn off</li> <li>Partially uprooted</li> <li>Uprooted</li> <li>Trunk snapped</li> <li>Tree stubbed</li> <li>Complete removal of tree from the ground, moved more than 5m</li> </ul>	Selects the damage state that best describes the damage sustained by the tree investigated.
Tree Damage Distribution	Single Choice	<ul> <li>No nearby trees</li> <li>Isolated (&lt;15%)</li> <li>Common (15% - 50%)</li> <li>Typical (50% - 75%)</li> <li>Uniform (80%-100%)</li> </ul>	Selects the tree damage distribution due to wind observed in the site.
Tree Fall Direction	Numeric Input Provides to degrees of to north. N 90 degree West: 270		Provides tree fall direction in degrees clockwise with respect to north. North: 0 degrees; East: 90 degrees; South: 180 degrees; West: 270 degrees.
Photos of Tree Damage	Close view photos taken from far enough distance highlighting the observed damage in trees. Sequence of overview photos taken from all accessible sides that show the tree damage distribution.		
Tower Damage State	Single ChoiceUndamaged Leaning, straight • Leaning, plastic hinge • Collapsed, anchorage failure • Collapsed, member failureSelects the dan best describes to sustained by the investigated.		Selects the damage state that best describes the damage sustained by the tower investigated.



Tower Fall Direction	Numeric Inpu	ıt	Provides tower fall direction in degrees clockwise with respect to north. North: 0 degrees; East: 90 degrees; South: 180 degrees; West: 270 degrees.
Photos of Tower Damage	Sequence of overview photos taken from all accessible sides of the tower showing overall damage. Close view photos taken from far enough distance highlighting the observed damage state of the tower.		
Signpost Damage State	Single Choice	<ul> <li>Undamaged</li> <li>Leaning, straight</li> <li>Leaning, plastic hinge</li> <li>Collapsed, anchorage failure</li> <li>Collapsed, member failure</li> </ul>	Selects the damage state that best describes the damage sustained by the tower investigated.
Signpost Fall Direction	Numeric Inpu	ıt	Provides signpost fall direction in degrees clockwise with respect to north. North: 0 degrees; East: 90 degrees; South: 180 degrees; West: 270 degrees.
Photos of Signpost Damage	Sequence of overview photos taken from all accessible sides of the signpost showing overall damage. Close view photos taken from far enough distance highlighting the observed damage state of the tower.		



< Back Hazard Information	Cancel Tree Damage State Done
2 Reference Files	G, Search
Windstorm Hazard Information	Undamaged
Wind Hazard Indicators Tree	Small branches tom off
Wind Hazard Indicator Information	Large branches torn off
	Partially uprooted
Tree Section	Uprooted
Tree species	Trunk snapped
Tree Height	Tree stubbed
Tran Designated Area	Complete removal of tree from the ground, moved more than Sm
TIDE PTUELIEU ATER	
Tree Height Unit	Clear Value
Tree Height Linit Feet Maryer	Chear Value
Tree Height Unit Feet Mener Tree Projected Area Unit	Clear Value Cancel Tree Damage Distribution Done
Tree Height Unit Feet Meser Tree Projected Area Unit Soft Som	Clear Value Cancel Tree Damage Distribution Done Q, Search
Tree Height Unit Feet Meet Tree Projected Area Unit Soft Som Tree Damage State	Clear Value Cancel Tree Damage Distribution Done Q. Search No rearby trees
Tree Height Unit Feet Meser Tree Projected Area Unit Sight Sigm Tree Damage State	Clear Value Cancel Tree Damage Distribution Done C. Search No nearby trees Isolated (<15%)
Tree Height Unit Feet Master Tree Projected Area Unit Sqft Sqm Tree Damage State Tree Damage Distribution	Clear Value Cancol Tree Damage Distribution Done Q, Search No nearby trees Isolated (<15%) Common (15% - 50%)
Tree Height Unit Feet Meter Tree Projected Area Unit Sqft Sqm Tree Damage State Tree Damage Distribution Photos of Tree Damage	Clear Visue Cancel Tree Damage Distribution Done (Q. Isersh No nearby trees Itelated (<15%) Common (15% - 50%) Typical (50% - 75%)
Tree Height Unit Feet Master Tree Projected Area Unit Sqft Sqm Tree Damage State Tree Damage Distribution Photos of Tree Damage	Clear Visue Cancel Tree Damage Distribution Done (0, Iserch No nearby trees Isolated (<15%) Cammon (15% - 50%) Typical (50% - 75%) Uniform (80% - 100%)
Tree Height Unit Feet Maper Tree Projected Area Unit Sqft Sqm Tree Damage State Tree Damage Distribution Photos of Tree Damage	Clear Vision Concel Tree Damage Distribution Done (), Search No rearby trees Isolated (<)5%) Cammon (19% - 50%) Typical (50% - 75%) Uniform (80% - 100%)

**Figure 4a.2.** Snapshot in iOS of "Windstorm Hazard Information" section in StEER Unified App. (Left) selection choice for windstorm hazard indicator and specific information on the selected windstorm hazard indicator; (Right) RFs choices for windstorm hazard indicator damage state ratings and damage state distribution.

## 4a.3 Coastal Hazard Information

Under this section information is gathered for flow condition measurement at the site. Flow condition measurement includes high water mark (HWM), runup, flow velocity, wave condition. Both direct measurement at the site and indirect measurement including evidence gathered using photos, videos, or post-event modeling are used for flow condition measurements. Table 4a.3 lists all the required fields of the Coastal Hazard Information section. See Figure 4a.3 for example screenshots of the coastal hazard collection interface.

Table 4a.3. Explanation of Required Fields in Section 4a.3: Coastal Hazard Information			
Field Name	Choice	Choice List	Description
Flow Condition Measurement Method	Multiple Choice	<ul> <li>Video Evidence</li> <li>Photo Evidence</li> <li>Evidence of Bores</li> <li>Post-event Modeling</li> <li>Field Measurement</li> </ul>	Selects all the methods used for flow condition (e.g., inundation depth, flow velocity, runup, etc.) measurement.



		<ul><li>Flow Surrogate</li><li>Other</li></ul>		
Flow Intensity Measure	Multiple Choice	<ul> <li>Maximum Flow Depth</li> <li>Maximum Flow Velocity</li> <li>Waves</li> </ul>	Selects the flow intensity measure measured/recorded.	
Maximum Flow D	epth			
Maximum Flow Depth Measure	Multiple Choice	<ul><li>High-water Mark (HWM)</li><li>Runup Limit</li></ul>	Selects all the flow depth measures recorded.	
Photos of High-water Mark	Overview and building; photo	Overview and closeview photos of HWM measured exterior/interior of the building; photos of metadata of HWM measurement instruments recording.		
Photos of Runup Limit	Overview and metadata of F	Overview and close view photos of Runup Limit measurement; photos of metadata of Runup Limit measurement instruments recording.		
Maximum Flow Ve	Maximum Flow Velocity			
Flow Velocity Measurement Method	Multiple choice	<ul><li>Video Evidence</li><li>Flow Surrogate</li></ul>	Selects all the flow velocity measurement methods used.	
Flow Surrogate Object	Multiple Choice	<ul> <li>Metal Pipe (e.g. Sign, Fence, Railing)</li> <li>Timber Pole</li> <li>Concrete Column</li> </ul>	Select all the objects used as surrogates for flow velocity measurement.	
Photos of Flow Surrogate Object	Photos taken of surrogate objects showing overview and damage location measured with a scale and/or crack gauge.			
Sketch of Pipe	Photos of the sketch of the surrogate pipe highlighting dimensions (diameter, thickness, height) and flow depth relative to pipe height.			
Sketch of Pole	Photos of sketch of the surrogate timer pole highlighting dimensions (diameter, thickness, height) and flow depth relative to pole height.			
Sketch of Concrete Column	Photos of ske (width, depth, relative to cor	Photos of sketch of the surrogate concrete column highlighting dimensions (width, depth, diameter, height), longitudinal and tie bar details, and flow depth relative to concrete column height.		





**Figure 4a.3.** Snapshot in iOS of "CoastalHazard Information" section in StEER Unified App. (Left) selection choice for flow condition measurement method and flow intensity measure; (Middle) RFs choices for flow condition measurement method, flow intensity measure, and maximum flow depth measure; and (Right) data fields related to High-water mark (HWM) metadata and processed HWM.

## 4b. Performance Assessment Survey

This section of the app is used when the assessment focuses on evidence of hazard impact on the built environment. Information is gathered on facility material, typology, structural and non-structural attributes, followed by performance information of different fidelity levels, and observed functionality state.

## 4b.1 Facility Information Required Fields

The Facility Information section gathers information regarding the facility being assessed including (i) basic metadata (site condition, facility material, construction year, number of stories above ground and below ground, facility configuration, occupancy type, retrofit, etc.) as illustrated in Figure 4b.1.1, (ii) structural information (see Figure 4b.1.2), and (iii) non-structural



information (see Figure 4b.1.3). Among these, the fields in Table 4b.1 are required fields; additional field priority observations are detailed in <u>Appendix C.4.1</u>.

Table 4b.1. Explanation of Required Fields in Section 4b.1: Facility Information			
Field Name	Choice	Choice List	Description
Facility Material	Multiple Choice	<ul> <li>Concrete</li> <li>Steel</li> <li>Wood</li> <li>Masonry</li> <li>Other</li> </ul>	Specifies standard materials for the <u>structural system</u> (one or more may apply). Note, structural system here refers to main load bearing elements, not the cladding/envelope material like brick veneer, glazing, etc.
Occupancy Category	Multiple Choice	<ul> <li>Residential</li> <li>Commercial</li> <li>Industrial</li> <li>Educational</li> <li>Government</li> <li>Public assembly</li> <li>Emergency services</li> <li>Historic</li> <li>Other</li> </ul>	Specifies standard occupancies (one or more may apply).
Structural System Category	Single Choice	<ul> <li>Wood Light Frames, W1</li> <li>Wood Frames, Commercial and Industrial, W2</li> <li>Concrete Moment Frame, C1</li> <li>Concrete Shear Wall Buildings, C2</li> <li>Concrete Frames with Infill Masonry Shear Walls, C3</li> <li>Steel Moment Frame, S1</li> <li>Steel Braced Frame, S2</li> <li>Steel Erames with Concrete Shear Walls, S3</li> <li>Steel Frames with Concrete Shear Walls, S4</li> <li>Steel Frames with Infill Masonry Shear Walls, S5</li> <li>Precast/Tilt-up Concrete Shear Wall Buildings, PC1</li> <li>Precast Concrete Frame, PC2</li> <li>Reinforced Masonry Bearing Wall Building with Flexible Diaphragms, RM1</li> </ul>	Specifies structural system from common US systems per FEMA 310.



#### Mobile Application Handbook

Building Resilience through Reconnaissance Version 2.0 | Released November 15, 2023

<ul> <li>Reinforced Masonry Bearing Wall Buildings with Stiff Diaphragms, RM2</li> <li>Unreinforced Masonry Bearing Wall Buildings, URM</li> </ul>	
UT WI	



**Figure 4b.1.1** Screenshot in iOS of "Facility Information" section in StEER Unified App. Note, majority of the fields here require answering 'Yes', 'No', or 'Unknown', with a few requiring numeric inputs. The required fields (\*) are either 'multi-select' or 'single-select' options. Follow-up questions may pop-up under a given field based on a user's 'Yes' response to a question.





**Figure 4b.1.2.** Screenshot in iOS of 'Structural Information' under the "Facility Information" section. One of the important required fields here is the 'Structural System Category' field. This will allow users to select the appropriate structural system for the assessed structure from a list of customary US structural systems based on FEMA 310.

Sack Facility Information	Cancel Interior Finishes (Fie Done	< Back Facility Information
2 Reference Files	Q Search	2 Reference Files
Architectural Components	Ceramic tiles	
Interior Partitions (Field Priority)	Carpet	Mechanical, Electrical, and Plumbing Equipment (ME&P)
Interior Finishes (Field Priority)	Laminates	Mechanical (i)
	Wood Paneling	
Click for selection from the interior finishes library	Vinyl Plank	Electrical
Despect and Appandance (Field Briggin)	Masonry Veneer	Plumbing
Parapet and Appendages (Neid Priority)	Stone	
Yes No Unknown	None	Are ME&P equipment anchored/braced?
Parapet and Appendages Type		Contents
·	Other	Are Contents Anchored?

**Figure 4b.1.3.** Screenshot in iOS of 'Non-structural Information' under the "Facility Information" section, which includes (left) Architectural Components, (middle) Exterior Envelope choice list, and (right) Mechanical, Electrical, and Plumbing (ME&P) and Contents. Each field is associated with a 'multi-select choice list' for selection of appropriate non-structural components.

#### 4b.2. Performance Information Required Fields

The Performance Information section of the app captures structural and non-structural performance information. The level of detail (and number of displayed fields) depends on the selected performance assessment: (i) **Basic Assessment (BA)** - which focuses on high-level global performance assessment (minimum no. of fields), (ii) **Load Path Assessment (LPA)** - which collects additional data on Critical Load Path Elements (CLPE) essential for resisting load effects from different hazards (intermediate no. of fields), and (iii) **Direct Component Assessment (DCA)**<sup>2</sup>. However, all of these assessments require the following:

• Visual evidence of structural damage through Overview Photos. Take a picture of each accessible exterior wall (walls 1-4). Make sure to stand far enough away from the building so the entire wall is in the photo from the foundation to the roof. Include the wall number in the caption or as a visual in the photo using number cards

<sup>&</sup>lt;sup>2</sup>LPA and DCA levels have not been activated in the unified app at this time and are omitted from Table 4.2.



- Visual evidence of structural component damage through *Detail Photos*. Take close-up pictures of component damage (e.g., column, beam, walls, connections, etc.) visible externally (e.g., at each accessible exterior wall of a building; include 1-4 numbering in your captions or in your photos). Avoid taking highly zoomed-in pictures that hinder identification of the location of the damage with respect to overall geometry of the structure or damaged component.
  - Use audio and video options or the free form "Overall Damage Notes" field to capture any other important structural damage information.
- **Describe the Observed Condition.** Answer some questions to record the overall condition of the assessed building. These questions either require inputting text/numeric values or selecting choices from the options provided. Answer as many questions as possible and particularly prioritize all the questions marked as **Field Priority**.
- **Assign a Global Damage Rating.** Based on the visual evidence of damage and observed conditions, select a global damage rating for the building from the five-point rating scale consistent with EMS-98 guidelines (see Fig. 4b.2):
  - **Negligible to slight**: No structural damage, slight non-structural damage
  - **Moderate**: Slight structural damage, moderate non-structural damage
  - **Substantial to heavy**: moderate structural damage, heavy non-structural damage
  - **Very heavy**: Heavy structural damage, very heavy non-structural damage
  - **Destruction**: Very heavy structural damage.

Required fields for this section of the app are summarized in Table 4b.2 with field priorities reported in <u>Appendix C.4.2</u>.

Table 4b.2. Explanation of Required Fields in Section 4b.2: Performance Information				
Field Name	Choice	Choice List	Description	
		Basic Assessment (BA)		
Overview Photos of Structural Performance	Sequence sides of th	Sequence of overview photos (e.g. foundation to roof) taken for all accessible sides of the structure.		
Closeview Photos of Structural Performance	Close-up photos of damaged components from far enough distance that allow identification of the location of the damage with respect to overall geometry of the structure or damaged component.			
Hazard Present at the Site	Multiple choice	<ul> <li>Ground shaking</li> <li>Landslide</li> <li>Liquefaction</li> <li>Lateral spreading</li> <li>Fire</li> <li>Tsunami</li> <li>Storm surge</li> </ul>	Choose all the hazards present in the site from the available list of hazards.	



		<ul> <li>Hurricane wind</li> <li>Hurricane wave</li> <li>Rain</li> <li>Flood</li> <li>Tornado</li> <li>Tree fall</li> <li>Wind-borne debris</li> <li>Water-borne debris</li> <li>Other</li> </ul>	
Global Performance Rating	Single Choice	<ul> <li>Negligible to slight</li> <li>Moderate</li> <li>Substantial to heavy</li> <li>Very heavy</li> <li>Destruction</li> </ul>	Global performance rating based on overall structural and non-structural damage.





Figure 4b.2 . Screenshot in iOS of 'Performance Information' section: (left) Visual evidence gathering of structural damage for Basic Assessment (BA), (middle) Observed structural damage of the assessed buildings at structural-level, and (right). Global performance rating guidance and five-point global performance rating scale.

#### 4b.3 Functionality Information Required Fields

The Functionality Information section of the app collects information that helps establish the current functionality state of the assessed building. The user needs to answer several questions related to building safety, story access, tenant safety, and tenant function, which will guide the functionality state rating of the building. Figure 4b.3 shows the screenshot of the fields captured by this section of the app. Required fields for this section of the app are summarized in Table 4b.3, whereas Field Priorities can be found in <u>Appendix C.4.3</u>.

Table 4b.3. Explanation of Required Fields in Section 4b.3: Functionality Information			
Field Name	Choice	Choice List	Description
Functionality State Rating	Single choice	<ul> <li>Functional</li> <li>Unfunctional but re-occupiable</li> <li>Unfunctional</li> </ul>	<ul> <li>(a) Functional: If the building meets all requirements for all four stages (Stage 1 to Stage 4), the building is considered as functional.</li> <li>(b) Unfunctional but re-occupiable: If the building meets the requirements for the first three stages of building safety, story access, and tenant safety, the building is considered unfunctional but re-occupiable.</li> <li>(c) Unfunctional: If the building does not fall under either item (a) or (b), the building is considered unfunctional.</li> </ul>



## 5.0 Record Update Tracking

This section is intended for Data Enrichment and Quality Control (DEQC) conducted virtually by data librarians once data gathering is completed by the FAST. Hence this section is not visible to the field teams. The fields included in this section track the Data Librarians, QC Progress Code, and QC Notes. Required fields for this section of the app are summarized in Table 5.1.

Tab	Table 5.1. Explanation of Required Fields in Section 5: Record Update Tracking					
Field Name	Choice	Choice List	Description			
Field Name QC Progress Code	Choice Single choice	<ul> <li>Choice List <ul> <li>In Progress</li> <li>Stage 1 has been completed. Location and address have been verified.</li> <li>Stage 1 has been completed but the location and address have not been verified due to an error or unusual uncertainty.</li> <li>Stage 2 and below have been completed. The minimum information for a completed assessment has been verified or added.</li> <li>Stage 2 and below have been completed but there is insufficient information to meet the minimum data standards for a complete record, or there is considerable uncertainty in the assignment of one or more critical fields.</li> <li>Stage 3 and below have been completed. The majority of Stage 3 fields have been filled in and validated with reasonable confidence in accuracy and precision.</li> <li>Stage 4 and below have been completed.</li> </ul></li></ul>	Description Specify status of Current stage of DEQC process.			
		<ul> <li>Final validation has been completed with automated and manual checks. The record is ready to be published in DesignSafe.</li> </ul>				
		<ul> <li>Final validation has been completed but errors have been identified that need to be corrected manually.</li> </ul>				



# Appendices

## Appendix A. Orientation to the Fulcrum Web Interface

After logging in at fulcrumapp.com, users will see a **Your Apps** menu. To view the data, click on the **map pin icon** () to the right of the name of the app of interest.



The bar at the left offers **Quick Filters** to select (if desired) time range or status class to view in the data display. Across the top of the data

Y

ш

screen you will see a filter icon, a three bar icon, and the total number of records icon. The status class is a color

records icon. The status class is a color coding applied to the record based on a field selected by the app designer. Normally this is associated with the global damage rating

designer. Normally this is associated with the global damage rating and color codes from cool to hot colors for increasing levels of damage. That legend is shown under the heading **Status** on the Quick Filters.

Click the filter right icon to set a range of one or more logical filters to your data view. Click the three bar right icon to select which of the data fields to display (or not). The number of records will update based

<sup>12566 records</sup> on these filter settings. **Clear All Filters** button will reset any applied filters.

A new record can be created by pressing the green plus button 🖭 on the upper right of the screen. Next to this button are three icons

 Clicking on the first of these buttons presents the data in a map view
 with colored pins at the locations of every acquired record. The toolbar at the upper left corner of the map allows users to zoom in and out (+ and - icons). The number of records will update at the top of the screen based on the number of pins in the selected geospatial view. Clicking on any pin yields a pop-up displaying the record details. The filter





12566 records

stack icon on the map tools allow users to change the basemap displayed in the map view. [This view displays only data for which geocoding is available]

 Clicking on the third of these view buttons displays the data in a table view . Users can interact with this table to quickly scan the entries under any field (by scrolling vertically) or to scan

🗹 Edit		Lekòl   School	2/25/2023, 4:32:26 AM	M7.
Quick View				
🗑 Delete		Lekòl   School	2/25/2023, 4:32:26 AM	M7.
Print				
> Open		Lekòl   School	2/25/2023, 4:32:26 AM	M7.
🔊 🚯 History		Lekòl   School	2/25/2023, 4:32:25 AM	M7.
View all med	lia		,	
			0/05/0000 4:00 05 444	7

across the entries of any record (scrolling horizontally). Clicking on the drop down menu to the left of any row opens a menu to edit, quick view (no editing), or perform other basic functions on the record. Clicking on headings at the top of the table enables a variety of sorting and filtering options (similar to Excel) [This view displays all data, regardless of geocoding status].

3. Clicking on the second of these button views yields a **split view** map and table that combines these two views. Zooming in using the map tools will update the table to list only the records displayed in the map frame (updating the number of records count at the top of the screen accordingly). Mouseovers of any map pin or row of the table will activate the record in the other half of the display. Records can be accessed



from the map or table views as described above. [This view displays only data for which geocoding is available]

When a record is selected through any of these views, a pop up appears. The pop up shows the record location, relevant metadata, and by scrolling down, responses to all of the fields. Clicking any embedded photo or video will enable another pop up giving additional geolocation data and



the ability to download the image at various resolutions. Clicking on an audio or video file creates a similar pop up and ability to play that recording. Records (including their geolocation) can be edited by clicking on the red pencil icon at the top of the pop up. Changes can be saved by clicking on the green checkbox (do this only if intentional edits were made). Clicking on the red encircled icon at the upper left exits without changing (safest way to close a record, unless you intentionally edited).



**Learn More:** The Resource Center at <u>www.fulcrumapp.com</u> has rich training materials to explain other more advanced features, including how to download the full dataset in a number of standard formats. The <u>Help Center</u> includes a searchable article database with additional technical guidance and the <u>Fulcrum YouTube channel</u> is another helpful resource.



#### Appendix B. Tiered Performance Assessment

**Objective:** Create standardized performance assessments implemented in a nested, interactive mobile applications and protocols to consistently guide more objective assessments for different reuse purposes



\* Damage Ratings currently reported on EMS-98 scale



## **Appendix C. Field Priorities**

Field Priorities for each section of the app are summarized below.

## Appendix C.1 App Selection Field Priorities

None. All the fields are Required Fields (RFs).

#### Appendix C.2 General Information Field Priorities

Table C.2. Explanation of Field Priority Fields in Section 2: General Information					
Field Name	Choice Choice List Description				
Facility Geolocation	Multiple short form questions		Collects facility address [2], owner contact information		
[2] Address auto-populates based on coordinates for US locations and can be edited by user if needed.					

## Appendix C.3 Supplemental Media Field Priorities

None. All the fields are Required Fields (RFs).

#### Appendix C.4a.1 Earthquake Hazard Information Field Priorities

Table C.4a.1 Explanation of Field Priority Fields in Section 4a.1: Earthquake Hazard Information					
Field Name	Choice	Choice List	Description		
Ground Motion Recording Station (GMRS) available near the site?	Multiple choice	Yes No Unknown	Select if any GMRS is available near the site.		
GMRS number/identification that is closest to the site	Text input		Provide the identification of the GMRS that is closest to the site.		

## Appendix C.4a.2 Windstorm Hazard Information Field Priorities

None.

## Appendix C.4a.3 Coastal Hazard Information Field Priorities

None.



Table C.4.1 Explanation of Field Priority Fields in Section 4: Facility Information				
Field Name	Choice	Choice List	Description	
Basic Metadata			•	
Number of stories below ground	Numeric input		Defines number of sub-levels	
Structural Drawing Available?	Single Choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Availability of structural drawing with the owner or the city administration/other jurisdiction.	
Occupied?	Single Choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Defines if the structure is (or appears to be) occupied at time of assessment	
Retrofitted?	Single Choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Check if any retrofitting to the structure is visible from exterior inspection.	
Instrumented?	Single Choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Check if the structure is instrumented for response monitoring through exterior/interior inspection or consulting with the facility owner.	
Injuries/Fatalities	Single Choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Check if there were any reported injuries/fatalities associated with the facility damage/failure.	
Structural Informatio	n			
Foundation Category	Single Choice	<ul> <li>Reinforced concrete mat slab</li> <li>Reinforced concrete spread or continuous</li> <li>Concrete slab-on-grade</li> <li>Masonry foundation</li> <li>Stone foundation</li> <li>Pile foundation</li> <li>Caisson foundation</li> <li>Cripple wall</li> </ul>	Choose from standard foundations common in formal construction.	

#### Appendix C.4b.1 Facility Information Field Priorities



		<ul> <li>Post and pier foundation</li> <li>Cast-in-place concrete piers</li> <li>Ground anchors and strapping</li> <li>Reinforced masonry piers</li> <li>Reinforced masonry stem walls</li> <li>Unreinforced masonry piers</li> <li>Unreinforced masonry stem wall</li> <li>Wood piers &lt;= 8 ft</li> <li>Wood piers &gt; 8 ft</li> <li>Unknown</li> </ul>	
Foundation Response Mitigation Measure Present	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Select if any response mitigation measures/devices are added to the foundation.
Foundation Response Mitigation Measure	Multiple choice	<ul> <li>Anchorage</li> <li>Base isolation device</li> <li>Breakaway basement/ground floor slab</li> <li>Flood opening in the foundation wall or cripple space</li> <li>Other</li> </ul>	Identify response mitigation measures/devices added to the foundation to reduce/limit forces/vibration in the structure
Wall Cladding	Multiple choice	<ul> <li>Unknown</li> <li>Veneer</li> <li>Prefabricated panels</li> <li>Glazed exterior walls</li> <li>Glass blocks</li> <li>Concrete cladding</li> <li>Aluminum siding</li> <li>Curtain wall</li> <li>EIFS</li> <li>Fiber-cement board</li> <li>Plywood siding</li> <li>Stucco</li> </ul>	Choose from standard cladding/envelope systems common in formal construction.



		<ul> <li>Vinyl siding (standard)</li> <li>Vinyl siding (high wind rated)</li> <li>Vinyl siding (unknown)</li> <li>Wood boards</li> <li>Wood shake/shingles</li> <li>None</li> <li>Other</li> </ul>	
Wall Anchorage Type	Multiple choice	<ul> <li>Unknown</li> <li>Anchor bolts with nuts and washers</li> <li>Anchor bolts with nuts and washers missing</li> <li>Metal straps</li> <li>Concrete nails</li> <li>Toe nails</li> <li>Other</li> </ul>	Identify how the walls are anchored to floor slab/roof framing.
Fenestration Protection and Type	Multiple choice	<ul> <li>Unknown</li> <li>Impact resistant doors</li> <li>Impact resistant windows</li> <li>Plywood</li> <li>OSB panel</li> <li>Hurricane shutters</li> <li>Storm panels</li> <li>Other</li> </ul>	Check the presence of fenestration protection and its type in the facility.
Sectional/Roll-up/Ga rage Door	Multiple choice	<ul> <li>Single garage door (standard)</li> <li>Single garage door (wind-rated)</li> <li>Single garage door (unknown)</li> <li>Double garage door (standard)</li> <li>Double garage door (wind-rated)</li> <li>Double garage door (unknown)</li> <li>Sectional door</li> <li>Roll-up door</li> <li>Other</li> </ul>	Check the presence of large doors and their type in the facility.



Non-structural Inform	Non-structural Information					
Interior Partitions	Multiple Choice	<ul> <li>Unreinforced Masonry partitions</li> <li>Reinforced masonry partitions</li> <li>Gypsum board partitions</li> <li>Lath and plaster wall partitions</li> <li>Glazed partitions</li> <li>None</li> <li>Other</li> </ul>	Choose from standard partitioning systems common in formal construction			
Interior Finishes	Multiple choices	<ul> <li>Ceramic tiles</li> <li>Carpet</li> <li>Laminates</li> <li>Wood Paneling</li> <li>Vinyl Plank</li> <li>Masonry Veneer</li> <li>Stone</li> <li>None</li> <li>Other</li> </ul>	Choose from standard interior finishes common in formal construction			
Are ME&P equipment anchored/braced?	Single choice	<ul> <li>All</li> <li>Most</li> <li>Some</li> <li>Few</li> <li>None</li> </ul>	Designate level to which ME&P's have been secured			
What ME&P equipment are located at elevated position?	Text input		List if there are any ME&P equipment located at elevated location to avoid water damage.			
Are Contents Soaked?	Single choice	<ul> <li>All</li> <li>Most</li> <li>Some</li> <li>Few</li> <li>None</li> </ul>	Designate leave to which contents have been soaked.			
Content Anchored/ Unanchored?	Single choice	<ul> <li>All</li> <li>Most</li> <li>Some</li> <li>Few</li> <li>None</li> </ul>	Designate level to which contents have been secured .			

## Appendix C.4b.2 Performance Information Field Priorities

 Table C.4.2 Explanation of Field Priority Fields in Section 5:Damage Information



Field Name	Choice	Choice List	Description
		Basic Assessment (BA)	
Observed Condition			
Number of Stories Affected?	Numeric Input	t	Specify the number of damaged stories in the building.
Affected Stories	Text input		Enter the specific stories damaged/affected, e.g., 1, 2, 4, 6.
Evidence of any soft story/weak story formation	Single choice	<ul> <li>None</li> <li>Minor</li> <li>Moderate</li> <li>Severe</li> </ul>	Specify degree of soft-story vulnerability observed.
Evidence of any torsional effect?	Single choice	<ul> <li>None</li> <li>Minor</li> <li>Moderate</li> <li>Severe</li> </ul>	Specify degree of torsional effect observed.
Racking damage to main lateral force resisting system/structural components?	Single choice	<ul> <li>None</li> <li>Minor</li> <li>Moderate</li> <li>Severe</li> </ul>	Specify degree of racking observed
Collapse, partial collapse, or building off the foundation?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Specify level of collapse
Evidence of potential falling hazard (e.g. chimney, parapet, facade, etc)?	Single choice	<ul><li>None</li><li>Minor</li><li>Moderate</li><li>Severe</li></ul>	Specify level of falling hazard observed
Ground slope movement or large fissure at building site?	Single choice	<ul> <li>None</li> <li>Minor</li> <li>Moderate</li> <li>Severe</li> </ul>	Specify level of ground failure observed.
Geotechnical hazard, scour, erosion, slope failure?	Single choice	<ul><li>None</li><li>Minor</li><li>Moderate</li><li>Severe</li></ul>	Specify level of geotechnical hazards observed.
Utility lines/fixtures submerged or severed by falling trees?	Single choice	<ul><li>None</li><li>Minor</li><li>Moderate</li><li>Severe</li></ul>	Specify level of utility line/fixtures damage



Evidence of flow shielding/channeling experienced?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Specify if facility experienced shielding/channeling effect
Evidence of debris impact/damming on the structure	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Specify if facility experienced debris impact/damming loading.
Evidence of floor slab uplift	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Specify if ground floor slab experienced uplift damage.

## Appendix C.4b.3 Functionality Information Field Priorities

Table C.4.3. Explanation of Field Priority Fields in Section 6: Functionality Information				
Field Name	Choice	Choice List	Description	
Stage-1: Building Sa	fety			
Unsafe placard posted?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the building posted with an "unsafe placard? If there is no placard, does the building appear structurally safe?	
Limited external falling hazards?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is there potential for external falling hazards?	
Fire suppression service operational?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the fire suppression service working (if applicable)?	
Stage-2: Story Acces				
Stair egress working?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Can tenants use the staircase for egress?	
Door egress working?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Can tenants use doors for egress?	
Stage-3: Tenant Safety				
Interior falling hazard present?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is there any falling hazard inside the building?	
Building envelope	Single	• Yes	Is the building envelope intact?	



intact?	choice	<ul><li>No</li><li>Unknown</li></ul>	
Stage 4: Tenant Fund	ction		
Limited envelope damage?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the damage to the building envelope limited?
Limited interior damage?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the damage to the building interior limited?
Elevator service working?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the elevator working (if applicable)?
Plumbing service working	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the plumbing service working?
Electrical power service working?	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the electrical power service working?
HVAC service working	Single choice	<ul><li>Yes</li><li>No</li><li>Unknown</li></ul>	Is the HVAC service working?

## Appendix C.5 Record Update Tracking

No field priority fields; this section is not completed in the field.

