CREW
Cascadia Region Earthquake Workgroup

Unreinforced Masonry (URM) Building Survey Workflow Guidebook

A Process to Help Communities Inventory Seismically Vulnerable Buildings

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Prepared by

CREW | Cascadia Region Earthquake Workgroup

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Introduction. Why Do a URM Survey?

Communities located in an earthquake hazard area should take stock of the buildings that are susceptible to severe damage in an earthquake.

A “sidewalk survey” of unreinforced masonry (URM) buildings creates an up-to-date inventory of structures that are prone to serious damage and even collapse during an earthquake. Some communities may choose to survey other building types as well, such as soft-story or tilt-up construction, which also perform poorly when the ground shakes. An inventory lays the groundwork for planning, prioritizing, and securing funding to strengthen or replace these older buildings, which can in turn improve safety, lessen the social and economic disruption caused by an earthquake, improve the community’s recovery, and save money in the long run.

An unreinforced masonry building in Seattle damaged by the magnitude 6.8 Nisqually earthquake in 2001. (Photo: FEMA)

Multiple Benefits

Establishing an inventory of seismically vulnerable buildings helps communities and building owners understand their risks, identify priorities, and explore options for retrofitting. Other benefits of an inventory include:

- **Helping communities to prepare an effective earthquake response plan.** Moreover, when an earthquake occurs, the survey data can help first responders anticipate structural damage, recognize the additional risk posed by aftershocks, and make informed decisions when working in and around URM buildings.
- **Laying the groundwork for creating a post-disaster assessment tool.** Both the survey process and the data-collection tool may be adapted for this purpose.
- **Informing discussions between local building departments and the owners of URM buildings.** In particular, building departments can use the data collected to help owners understand their risks and their options, including the pros and cons of upgrading versus demolition.

- **Streamlining the local building department's permitting process.** In particular, the data can be used to prompt and inform plan reviews that a building department may do prior to issuing a permit. For example, if a building is identified as a likely URM building, it can be automatically selected out and flagged as ineligible for over-the-counter reroof permits. This both makes it easier to automate simpler commercial reroof permits for non-URM buildings, and allows city staff to focus their time and attention on taking a closer look at seismically vulnerable buildings to make sure that any required safety retrofitting (such as to bolt the parapets to the structure and secure the roof diaphragm) is incorporated into the reroofing plan.
- **Focusing attention on the need for seismic design standards and retrofitting.** For example, the data can be used to:
    - Inform conversations with state legislators and local representatives about seismic hazards, building codes, and the need for funding to help pay for seismic retrofitting of vulnerable buildings.
    - Educate the public about seismic hazards, building codes, and the importance of retrofitting or replacing vulnerable buildings in order to improve safety and reduce economic and social disruption after an earthquake.

Moreover, if community volunteers are engaged in surveying potential URM buildings, the survey itself becomes an opportunity to educate community members about the hazard, show them how to identify buildings at risk, and give them a sense of ownership both in the survey process and in the development and implementation of solutions that will make the community more resilient.

How Does a Sidewalk Survey of URM Buildings Differ from Rapid Visual Screening (RVS)?

The central purpose of the URM sidewalk survey process described in this guide is to give local jurisdictions a simple and relatively inexpensive method for creating an inventory of unreinforced masonry buildings in the community. The process is designed so that the survey can be done by trained volunteers with no prior experience in building design or construction.

By contrast, the Rapid Visual Screening methodology (formally known as FEMA P-154) requires that the people who do the screening "be trained and experienced in building construction." This is because the screeners must be able to make assessments that result in a Structural Hazard Score for each building, which includes making decisions that will modify the score. The score itself indicates the probability that the building will collapse in an earthquake.

The two methodologies can complement one another: the URM-building inventory created through the work of the volunteer surveyors can help the jurisdiction identify and prioritize buildings that should be the focus of Rapid Visual Screening later. In this way, the inventory can facilitate a strategic and cost-effective use of specialist personnel and resources. Both processes can serve as precursors to a more detailed seismic evaluation, such as the ASCE 41-23 *Seismic Evaluation and Retrofit of Existing Buildings*.

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Section 1. Begin Pre-Inventory Planning

Bring Together a Planning Team

Who's on the Team?

Planning team members may come from:

- **The local agency or organization that is taking the lead**—for example, a city or county planning/building department, emergency management office, fire department, downtown association, chamber of commerce, or historic preservation commission.
- **State-level entities**, such as the emergency management department, the agency in charge of the preservation of historic buildings, or the seismic safety commission. Ideally, a state-level partner will be able to provide uniform guidance on what baseline information a survey should collect and how terms should be defined, ensuring that data collection is consistent across the state, adequate for mitigation and planning purposes, and ready to be inputted into a statewide database (if the state has one).
- **Local partners/project champions**, such as community members with an interest in the preservation of historic buildings or concern for community safety and resilience.

Who Should Be Consulted or Informed?

The city or county building/planning department should be consulted and involved in the survey even if they are not leading the effort. Other collaborators or entities who might be consulted during the planning process include a county assessor's office and a city or county IT department, communications team, or public information officer.

The planning team should also identify who should be informed, even if they will not be directly involved in planning or participating. This might include certain local public agencies (such as the police department) and elected officials (such as the mayor).

If a state agency will lead the planning process, it is good practice for them to inform their counterpart at the county level: for example, a state emergency management agency that plans to work with a city to conduct a survey should inform the relevant county emergency management agency. The county agency may be able to help support the effort with additional resources.

Who Facilitates?

To ensure that the survey planning team stays on track, appoint a single person to be the planning facilitator. The facilitator will take charge of:

- Scheduling meetings.
- Preparing the agenda.
- Facilitating meetings and team communications.
- Keeping track of who is doing what, which tasks have been accomplished, and what steps still need to be taken.

Points of Contact

In addition to the planning facilitator, it may be useful to designate particular members of staff in each participating agency/organization to coordinate their respective contributions to the effort and to serve as the points of contact for the planning facilitator.

How Many Hours to Prepare for a Survey?

Outside of meetings, the number of hours it takes to prepare for a survey is difficult to predict, as this varies case by case. The following are examples from a multi-day URM survey of approximately 600 buildings in a mid-size city; these tasks were identified by planning team members as the "heaviest lifts" in terms of hours:

- A GIS specialist spent an estimated 90 hours on the survey project, including about 40 hours manipulating data and preparing the Survey123 application to make a city-specific survey, based on a model first developed for a smaller community's URM survey. This work included:
    - Attending planning meetings.
    - Collecting existing data by sifting through various sources of building and parcel information in order to generate the interactive survey map and to program the app to pre-fill responses to certain survey questions based on spatial location and existing data sets (such as the age and address of a building).
    - Being on hand to provide technical support on the day of the survey.
    - Setting up the app for use in the quality-control (QA/QC) review of the survey data.
- Other members of the survey planning team participated in reviewing and pre-screening buildings (based primarily on age and sometimes "Street View" in Google Maps) in order to identify which buildings were clearly not unreinforced masonry and could therefore be removed from the list. They estimated a total of 40 hours (collectively) for this activity.
- Both city staff and volunteers were recruited to participate on the first day of the survey, forming approximately 20 survey teams. The planning team estimated that it took 20 hours to create and assemble survey training packets for the survey teams. Preparing the packets was a joint effort, so the hours were spread amongst several planning team members over the course of several days.

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Define the Scope

The survey planning team should create a project charter that defines the scope and priorities for the survey, beginning with identifying the primary purposes for conducting the survey and specifying how the resulting data will be used. These decisions will then make it easier to set the survey's parameters.

Among the questions to consider when defining the scope are:

- Will we survey URM buildings only, or include other seismically vulnerable building types, such as soft story?
- Which buildings (single-family residential, multi-family residential, commercial, public, etc.) will we include in the survey?
- What are the geographical boundaries of the survey area?

Decide Which Areas to Survey/Inventory

Decisions about which areas of the community to survey can be revisited and adjusted as the planning team gathers information during the planning process. Smaller jurisdictions may be able to survey all suspected unreinforced masonry (URM) buildings in one or two days; larger jurisdictions may need to prioritize areas and assemble their inventory in stages over time.

Priorities for selecting the survey areas may include:

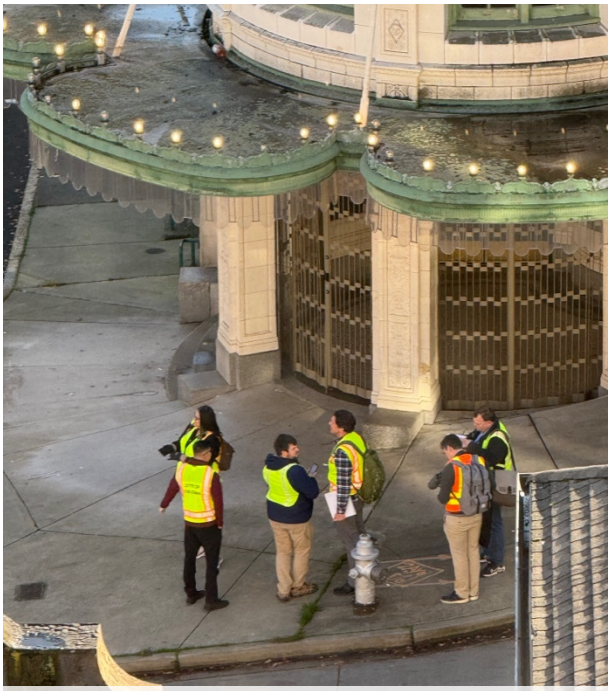
- Relative importance (e.g., cultural/historical or economic) to the city/community.
- Expected impacts and wider-community consequences of building failures during an earthquake. For example, survey planners might prioritize:
    - Areas with a concentration of older buildings and high occupancy, such as an historic downtown.
    - Places where critical facilities may be in or adjacent to buildings suspected of being unreinforced masonry.
    - Streets where debris from URM buildings damaged during a future earthquake could block vital transportation routes.
- Accessibility and quality of existing data on the parcels and buildings (that is, data used to pre-screen buildings, provide a framework for surveying them, and construct the survey maps).
- Anticipated number of volunteers/surveyors and realistic estimate of how many buildings they can survey in the time allotted.
- Proximity to the location where volunteers/surveyors will meet for orientation and training.

How Many Buildings Can Be Surveyed in One Afternoon?

How much time will be needed to survey a community's suspected unreinforced masonry (URM) buildings will of course depend on multiple factors, including the number of buildings, how dispersed they are geographically, how much information volunteers are asked to collect, the method used for data collection, and the training and experience of the volunteers.

The following is an estimate based on a one-day survey of 298 buildings in Tacoma, Washington:

> Approximately 60 people participated in conducting the survey. These were divided into 20 teams. Each survey team included at least one person with previous experience or expertise in identifying unreinforced masonry. On average, each team surveyed between 14 and 15 buildings in one afternoon (spending about 15 minutes per building).



One of the Tacoma survey teams sets out to view their assigned buildings. (Photo: CREW)

In an earlier pilot URM survey in Everett, Washington, volunteer teams averaged approximately 20 minutes per building. This survey used an app and process similar to that used later in Tacoma; however, Tacoma's app could automatically populate some data fields that Everett's app required volunteers to fill in manually.

A multi-day survey of URM buildings in Clark County, Nevada, employed engineering student interns and county staff rather than volunteers. Surveyors collected data by means of a purpose-built app and averaged 10 minutes per building. Clark County's app had fewer data fields to fill in than the Tacoma and Everett apps, which may account in part for the shorter average-time per building.

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Determine the Planning Timeline

Single-Day versus Multi-Day Survey

Whether a survey can be completed in a single day, or will require multiple days over an extended period, will depend on:

- The size of the jurisdiction and the number of buildings to be surveyed.
- The number of volunteers/surveyors who participate.
- The priorities of the planning team and the parameters that they set for the survey.

If more than one day is needed to complete the inventory, the process and materials that the planning team developed for the first day can be reused. Assuming that the original volunteers/surveyors are available to participate on the additional days, the training may be shortened to a "refresher" course or even eliminated.

Multi-Year Inventories

Very large jurisdictions might need to plan for a sustained effort spanning a period of years. Similarly, a statewide inventory program led by a state agency is likely to be a multi-year investment. In these cases, good documentation and forward planning is key to ensuring continuity and will make progress easier. Develop a well-considered process and framework at the beginning—and because personnel could change before the inventory is completed, be mindful of what the next team will need in order to carry on with the work.

Select the Survey Date(s)

Whether planning a one-day survey or a survey that will occur on multiple days over a period of weeks or months, it is best to decide the date(s) of the survey and then plot the planning timeline backwards from that point.

Considerations for choosing the date(s) include:

- **Season and weather conditions.** Select a date at a time of year when daylight hours are adequate and the weather is likely to be mild and dry, as volunteers will be outside for hours surveying buildings and recording data.
- **The planning timeline.** Estimate the number of weeks required for the planning team to meet and accomplish the tasks involved in setting up the survey and recruiting volunteers. Take into account the schedules and availability of core planning team members and how frequently the planning team and any workgroups will meet (for example, every week, every-other week, or once per month). The team and workgroups may need to meet more frequently as the date of the survey approaches. Timelines for different communities will vary with circumstances and complexity; for example:
    - The planning timeline for Everett, Washington, was about 12 weeks, with the planning team meeting 7 times (on average twice per month).
    - The planning timeline for Tacoma, Washington, was 15 weeks, with the planning team meeting 12 times (on average once per week).
- **The community calendar/conflicting events.** Make sure you're aware of:
    - Community events (for example, street fairs, markets, sidewalk sales, and festivals) already scheduled in the areas to be surveyed.
    - Holidays or conflicts that might affect the availability of volunteers.

Planning Process & Survey Milestones

The following outline assumes that the survey will take place on a single day, but it can be adapted to incorporate additional survey days.

1. Planning team kickoff meeting
2. Finalize the date of the survey and invite all planning team members
3. Define the scope, set parameters for the survey, and decide what data will be collected
4. Define the survey blocks and collect existing building data
5. Complete the setup of the survey app or other data collection tool
6. Invite/recruit and register survey participants
7. Notify building owners/begin outreach to inform the public about the survey
8. Arrange meeting/operations space for the day(s) of the survey; make arrangements to serve lunch or refreshments (if included)
9. Prepare orientation and training presentations that will train volunteers/surveyors to recognize and record features of a URM building and ensure that all surveyors know how to use the data collection app/tool
10. Prepare training packets for survey teams
11. **Survey day** (present training, distribute packets to survey teams, and begin survey). *Optional: end-of day "hotwash" (planning team meets for a quick review and critique)*
12. Set the dates for a quality assurance/quality control (QA/QC) review of the survey data
13. Complete the setup of the QA/QC-review app/tool
14. Recruit qualified volunteers for the QA/QC review
15. Prepare the QA/QC training presentation
16. Deliver the training for QA/QC reviewers
17. Conclude the QA/QC review

After-Action Review & Poll

Additional activities that the planning team may want to include in their process are:

- A post-survey opinion poll. If this is digital, give the link to participants after the survey; request their feedback on their experience of the training and survey process. (See examples in *Appendix A*.)
- An after-action review. Schedule a date and time for the planning team to meet in order to review feedback from participants, identify lessons learned, and formulate tips and recommendations for improving the training or other aspects of the process.

The results can be used to improve subsequent survey days or plans for later surveys; and they can be shared with neighboring jurisdictions who are thinking of doing their own URM-building surveys.

How Many Meetings?

The number of planning meetings is likely to vary depending on factors such as the size of the jurisdiction, the size of the survey, and who takes the lead. The following is a model based on a survey of URM buildings in Tacoma, Washington.

- Kick Off. The planning team and primary collaborators hold a preliminary meeting to identify tasks, propose a survey date, determine if others need to be involved or consulted, discuss likely sources of volunteers for the survey, assign initial tasks, and agree to a timeline and meeting schedule.
- Beginning 8–12 Weeks Prior to the Survey Date:
    - The planning team and primary collaborators meet together on average once per week, every week until the date of the survey. They finalize the survey date, identify needs and potential resources, plan the survey, assign tasks, share progress, and problem-solve any difficulties.
    - The team members of the local lead agency/organization meet separately (4-5 times) to discuss the survey with colleagues and leadership and to coordinate or work on their assigned tasks, such as determining what buildings in which parts of the community will be included in the survey.
- A week or so before the survey date:
    - Those assigned the task of assembling packets for the survey teams meet to make copies of the contents and put the packets together.
    - The planning team meets to preview and rehearse the training presentations and review survey-day logistics.
- Following the survey day, the planning team meets 3–4 times to coordinate the quality assurance/quality control (QA/QC) review of the survey data; for example, to discuss scheduling, logistics, and possible QA/QC volunteers, to plan the training and review the content of training presentations, and to deliver the training to QA/QC volunteers.

An Option for Smaller Jurisdictions

Small communities with relatively few buildings to inventory may want to consider collaborating with similar neighboring jurisdictions to jointly plan and prepare to conduct their building surveys. While each would conduct their own inventory separately, they can reduce their workload by meeting jointly to plan the surveys and by making use of the same data-collection criteria and the same trainer and training materials—and perhaps even the same group of survey participants.

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Identify Resources Needed

After determining the scope and outlining the steps and activities required to plan, organize, and implement the survey, including generating training materials, the planning team should:

1. **Determine what resources will be needed**, including not only tools, such as a survey app, but also:
    a. Human resources (both to perform tasks and contribute expertise).
    b. Resources for uploading, storing, and sharing the data once it is collected.
2. **Determine the budget**. Costs may include:
    a. ArcGIS Survey123 or other survey-tool. (A local or state department or agency may already have an ArcGIS subscription and be willing to share it for the purposes of doing the survey.)
    b. Staff time (for planning, preparing for, conducting, and participating in the survey)
    c. App developer or GIS specialist
    d. Communications and outreach; for example:
        i. Photocopying
        ii. Postage (if mailing letters about the survey to building owners)
        iii. Social media campaign
    e. Printed copies/photocopies and binders for survey training packets
    f. High-visibility safety vests for volunteers
    g. Lanyards and name tags for volunteers
    h. Bottled water
    i. Breakfast, lunch, or other refreshments for volunteers
    j. Fee or rent for a meeting space for training and orientation
    k. Public transportation passes
    l. Parking passes/reimbursement for parking
3. **Find and secure funding.**

The planning team may be able to defray some costs by:

- Finding sponsors for particular expenses, such providing lunch to volunteers or donating the use of a meeting room.
- Asking volunteers to bring some of the items needed (such as their own high-visibility vests, public transportation passes, refillable water bottles, and so on).
- Borrowing items (such as high-visibility vests) for volunteers to use.

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Choose a Data Collection Tool

Survey data can be collected in any number of ways. A low-tech option is to provide surveyors with clipboards and paper forms that surveyors simply fill out as they look over their assigned buildings. The downside to this method is that later, the data must be manually entered into a digital spreadsheet or database. Nevertheless, this option can be a workable choice for jurisdictions with fewer than 100 suspected unreinforced masonry (URM) buildings to survey.

Similarly, both Google Workspaces (i.e. Google Forms) and Microsoft 365 (i.e. Microsoft Forms) offer options for creating a survey form that will load submitted data into a table. This works adequately for data collection but may present more work at the data-processing end of the undertaking.

At present, a software application (such as Survey123 or Fulcrum) on a mobile device is the preferred way to collect survey data and photos. An app or browser-based survey is quick and easy to use, allows users to upload photos as well as input data, and saves time by eliminating the need to go through each written form and manually transfer the data into a digital format.

Examples of Survey Apps

Purpose-Built for Clark County, Nevada

A survey in Clark County, Nevada, began before customizable out-of-the-box options like ArcGIS Survey123 were available. Clark County started out collecting survey data using paper forms, but then a grant allowed them to hire a developer to create a purpose-built iOS app. This served very well, and it was a worthwhile investment given both the number of buildings to be surveyed (more than 14,000), and the plan to conduct the survey in phases over a period of years. The downside emerged unexpectedly when the COVID pandemic hit: the survey had to be shut down, but the maintenance fees to support the app still had to be paid. Because the app was built specifically for the URM survey, it could serve no other purpose in the interim.

Survey123 in Washington State

Survey123 is an Esri product being used in the state of Washington to pilot URM inventories in local jurisdictions. The state Department of Archaeology and Historic Preservation (DAHP) is developing a statewide URM database and portal to store inventory data. DAHP will also host a Survey123 application that any jurisdiction in the state can use when conducting a URM survey locally. One advantage of Survey123 is that it makes it easy to incorporate existing GIS data sources, because ArcGIS (Survey123) and its data types conform to the same industry standards.

Go to Section 4. Prepare for Data Collection

Gather Existing Building Data

Having made preliminary decisions about which areas to survey, the planning team should choose the date range for buildings to include in the inventory and collect existing data. Gathering information about the buildings prior to the survey will help the planning team to:

- Filter out any buildings that can be excluded from the survey; for example, buildings may be excluded if data show that they are not built of masonry or that they were built after seismic building codes were enforced.
- Create the maps that volunteers/surveyors will follow during the survey.

It might also be possible to customize the survey app/tool so that some data fields, such as the building address or construction date, can be pre-populated: this saves time when surveyors are in the field.

Identify the Cut-Off Date for Buildings in the Inventory

Before gathering existing data on the areas to be surveyed, establish the cut-off date for the age of buildings to be included in the survey: for example, the cut-off date might be a year or two after the jurisdiction adopted and began enforcing a building code or local ordinance that ended the construction of unreinforced masonry (URM) buildings. By setting the cut-off date a bit later than the date of code adoption, the planning team will catch any URM buildings that were already permitted and under construction before the ordinance or code went into effect.

For instance, a URM-building survey conducted in Tacoma, Washington, focused on buildings constructed before the year 1977. Clark County, Nevada, meanwhile, relied on a preliminary URM-building assessment that set 1974 as their cut-off date. Seattle, Washington, chose the date 1945, based on the adoption of a local ordinance in 1942 that required seismic lateral bracing, which in effect eliminated URM construction even before the adoption of a 1974 code that officially prohibited it.

Consult Multiple Sources

Existing data on buildings in the survey area may come from a variety of sources, so be prepared to look in several places—such as records in different departments in the city or county, and in more than one online database or report—in order to assemble and verify (when possible) the pieces of information needed for the survey. For example, relevant inputs might include:

- Zoning designations and other information about building occupancy.
- Digital maps with layers of data, such as a layer showing building footprints.

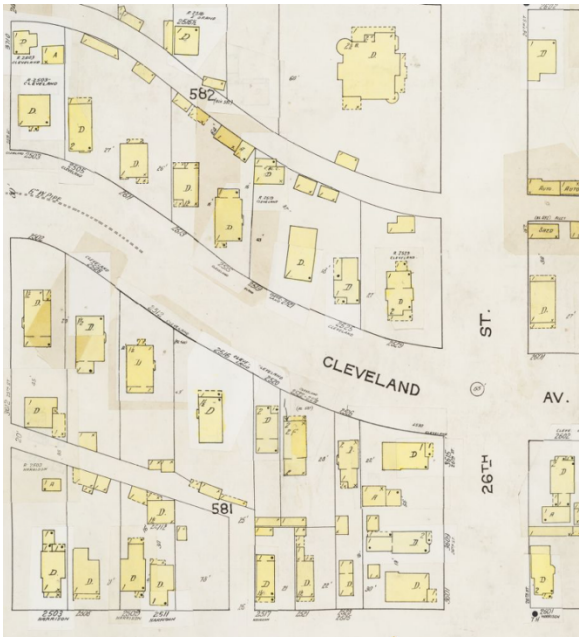
- Parcel data, including the address, age, use, square footage, and ownership of buildings. Typically, this data is collected by the county assessor/treasurer. (See, for example, information available through the City of Tacoma's Public DART Map: dart.cityoftacoma.org/#20230815)

Historic registers may be a source of useful data, as may building databases maintained by the state. For example, in the state of Washington, the state Department of Archaeology and Historic Preservation (DAHP) is the contact point for historic registers; DAHP also maintains a database (WISAARD) that includes build dates for many older structures in the state.

Sanborn Maps may be another useful historic resource, assuming that the community is one of those for which the Sanborn Map Company (1867-1970s) once produced a map for fire insurance assessment purposes.

It is also worth inquiring whether any data has already been collected on URM buildings in the community, either locally or through a state-level inquiry. URM surveys in Nevada, for example, can get started with a report by the Nevada Bureau of Mines and Geology that compiled data on potential URM buildings statewide.

An online resource that may be helpful, both for pre-screening buildings for the survey and for the quality assurance/quality control (QA/QC) review afterwards, is Google Street View, including aerial views that show buildings from above.



Excerpt from a Sanborn Fire Insurance Map for Everett, Washington (accessible on the Everett Public Library website: epls.org).

Use Local Knowledge to Identify Sensitive Spaces

Another factor to consider when refining the choice of areas to be surveyed is whether sensitive entities or occupants may be present. For example:

- A building that houses the county jail or is occupied by a security branch of the government may need to be excluded from the survey or included only if permissions are arranged in advance.
- School buildings may need to be surveyed on the weekend when students are not present.
- A building used as a clinic or shelter for vulnerable people might require special handling, including both communicating in advance with the people who run it, and providing individualized guidance or protocols to the survey team assigned to it.

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Create a Plan for Communicating with the Public

Communicating with building owners and the public about the survey both ensures transparency and provides an opportunity to raise awareness about the earthquake hazard, which can in turn help build support for and investment in mitigation. When shaping the plan, it may be helpful to consult a media or communications specialist, or a public information officer (PIO), if one of the public agencies involved has such a person on staff.

Communicating before the Survey

In the weeks leading up to the survey, consider engaging in public outreach to explain:

- What the survey is.
- When and where it will take place.
- Why it is being done.
- How the resulting data will be used.

By clearly articulating the core messages to be shared, the planning team can make sure that all communications about the survey are consistent and that likely questions or concerns are anticipated and answers are prepared. Likewise, volunteers/surveyors can be briefed on how to answer questions as well as where to direct people for more information.

The planning team may also want to specify which audiences, such as building owners or tenants within the survey area, they particularly want to reach. The team can then identify the best channels or means of communicating with those groups.

Options for public outreach include:

- Mailing a letter or sending an email to businesses and/or building owners in the survey area(s) so they are informed prior to the survey day. (See examples in *Appendix A*.)
- Sending a press release to the local newspaper or to organizations with newsletters that are likely to reach those living or working in the area(s) to be surveyed.
- Asking participating or interested agencies and organizations to post a statement about the survey in their blogs or newsletters and also share it through their social media channels.

Consider:

- Designating a particular office or person to be the contact who will respond to questions from the public; for example, this might be a participating agency's public information officer (PIO) or communications office.

- Setting up a webpage that provides basic information about the survey, including why it is being done, what will be done with the results, and who to contact for more information. (If the survey is part of a larger statewide effort, the lead state agency may already have a webpage that can serve this purpose.)
- Preparing printed materials, and/or a QR code linking to an informational webpage, that volunteers/surveyors can share with members of the public who ask questions.

Communicating after the Survey

As the day of the survey approaches, give some thought also to preparing post-event communications that publicize what was accomplished and highlight why the inventory is important.

- Plan to take photos of the survey teams as they meet for training or to survey buildings: the photos can be shared in press releases, blogs, articles, and social media posts.
- Consider including information about mitigation, potential funding resources, and stories about successfully retrofitted URM buildings, including how the retrofitting was funded.

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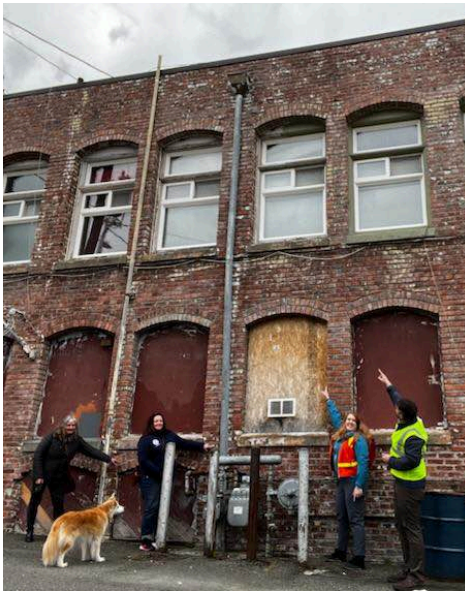
Decide Who Will Survey the Buildings

Various models for doing "sidewalk" surveys of unreinforced masonry (URM) buildings have been tried with success in recent years, including training non-specialist volunteers to survey buildings (this can be a good option for smaller jurisdictions), making use of public employees and trained volunteer professionals to do the surveying, and employing trained engineering interns alongside county staff.

Volunteers

Recruiting and training volunteers from the community both allows smaller jurisdictions with limited resources to conduct an inventory/survey, and has the advantage of engaging community members in the project, leading to increased public awareness of the hazard and support for the inventory. With suitable training, even volunteers with no prior experience can quickly acquire the skills needed to survey unreinforced masonry buildings as well as other seismically vulnerable building types.



A group of volunteers survey an unreinforced masonry (URM) building during a one-day survey in Everett, Washington. (Photo: Washington State Emergency Management Division)

Potential sources of volunteers include:

- A Main Street Association or other downtown/local business association.
- A local (city/county) historic preservation commission or association.
- Local chapters of community-oriented clubs.
- A local Community Emergency Response Team.
- Community residents / the general public.
- A neighboring community's downtown or historic preservation association, if they are thinking of conducting a similar survey in their community and want to learn by doing.

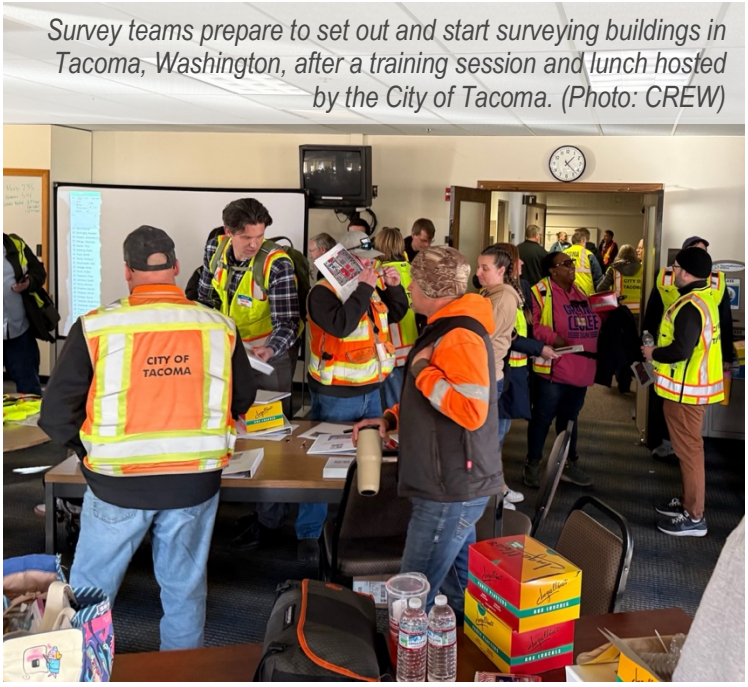
In some communities, it may also be possible to recruit volunteers who already have relevant experience; for example:

- Engineering students from a nearby college or university.
- Members of the local or regional chapter of a professional association of engineers (such as EERI) or architects.
- Professional engineers living in the community and working at local firms willing to "sponsor" the survey.

Public Employees

An option that may be feasible for larger jurisdictions is to recruit city or county employees — for example, staff members from whatever public agency is hosting and organizing the survey, such as a city building department.

The City of Tacoma in Washington, for instance, chose to recruit their own salaried employees along with contract employees (the latter required overtime pay). For the first day of the survey, they also welcomed volunteers from neighboring city and county government departments and professional organizations. Once trained, the Tacoma employees could carry on doing the survey on additional days to cover all of the areas identified by the planning team. This was an advantage for a city with more potential unreinforced masonry (URM) buildings than could be surveyed in a single day.



Survey teams prepare to set out and start surveying buildings in Tacoma, Washington, after a training session and lunch hosted by the City of Tacoma. (Photo: CREW)

Clark County, Nevada, meanwhile, chose to conduct their county-wide survey over several years using engineering student interns, supervised by staff from the Department of Building and Fire Prevention. The interns received approximately 40 hours of training, both to do a visual assessment of a building's features and to use rebar detectors and thermographic cameras if permitted inside by the building's owner.

One advantage of using paid student interns with extensive training was to reduce the need for a full quality assurance/quality control (QA/QC) review of the data collected. Instead, a brief, weekly check by supervising staff was sufficient. On the other hand, paying the interns added to the budget. Also, because the survey of so many structures was done in phases over a period of years, the extensive training had to be repeated as the trained interns left and new interns took their place.

Liability Considerations

Depending on the entity leading the survey, the question of liability may arise when community volunteers do the surveying. In some cases, asking volunteers to sign a liability waiver will be adequate; in others, the lead agency may choose to limit participation to its own employees and to volunteers who take part in their professional capacity (such as employees of a sponsoring business or organization, or building officials from a neighboring city) and so are covered by their own employer's liability insurance.

Registration

Having first identified likely volunteers/surveyors, set up a means of registering them: for example, an online event registration platform, or a list based on acceptance of a calendar-invite. Be sure to communicate to volunteers/surveyors what the cut-off date is for registering.

Registration is recommended so that the planning team will have reliable contact information, can estimate the number of participants, and knows which volunteers/surveyors have relevant prior experience or professional training. This information can be used to determine:

- How to distribute volunteers/surveyors into survey teams.
- How many survey teams there will be.
- How many buildings can be surveyed in the time available.
- How large the meeting space for orientation and training must be.
- How many training packets and other items (e.g., high-visibility vests) will be needed.
- How much food to order, if breakfast, lunch, or snacks are provided during training.

The registration list can likewise be used to:

- Communicate with volunteers/surveyors prior to the survey regarding details, including:
    - Where and when to meet on the day(s) of the survey.
    - What the schedule is for orientation/training and conducting the survey.

    - Where to park.
    - What to bring.
    - Volunteers' food order/menu selections, if the survey planning team is providing breakfast or lunch during the orientation and training session.
    - Who to contact if volunteers/surveyors have questions.
- Create a sign-in/sign-out sheet to help keep track of volunteers/surveyors on the day(s) of the survey.

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Section 2. Prepare and Present Training

What Training is Needed?

Provide General Orientation

One component of the training should provide survey participants with:

- An overview of survey-day logistics and safety.
- Guidance for communicating with the public (for example, what to say to people who approach survey teams on the street and ask them what they are doing).

Explain Survey Protocols

Make sure volunteers/surveyors understand what is expected of them. For example, explain that:

- The objective is to perform a brief "sidewalk survey" of suspected unreinforced masonry (URM) buildings in order to produce an inventory of confirmed URM buildings.
- Survey team members should stay on public sidewalks; they should not walk up driveways or otherwise step onto private property or enter a building when surveying it, unless examination of the interior is both part of the design of the survey and permitted by the owner of the property. *(A survey that looks at interior features will most likely require engineers or related subject matter experts in place of trained volunteers.)*
- When taking photos of the building, survey team members should make sure there are no people in the frame.
- If a volunteer team is unsure whether a particular building is a URM building, they should simply photograph the building and its features as prompted in the survey form/app/tool, do their best to answer the survey questions about the building, and then move on.
    - Assure volunteers that all of the data gathered will be reviewed by a building expert.
    - Building experts can be sent out later to assess any buildings that require closer inspection to make a determination.

Safety. The safety of survey teams is a priority and should be emphasized during the training session. Share protocols such as:

- Stay together and be aware of your surroundings.
- If you feel unsafe for any reason, withdraw and do not continue surveying in that area.
- Do not enter dangerous spaces in order to get a better view of a building or to take photos.

For additional examples, see the safety checklist used by Tacoma, Washington (*Appendix A*).

Sensitive spaces. Teams assigned to a survey area containing sensitive spaces (such as a jail, school, mental health clinic, or shelter) should be given individualized guidance so they know what to expect and what to do—in particular, whether to exclude the building from the survey or follow specific protocols when they survey it. Be sure to assign sensitive spaces to teams whose members feel comfortable with the conditions and prepared to speak with any people they may encounter.

Documenting the survey. Notify all participants if they are likely to be photographed or filmed as they work: for instance, if the planning team will take photos to use in a press release or news story.

Demonstrate How to Use the Survey Tool

A critical part of the training is to teach volunteers/surveyors how to use the survey app or other data-collection tool. Be sure to draw attention to:

- Priorities for data collection (to ensure consistency) and guidelines for taking photos.
- Terms used in the app/data-collection tool and defined in the training materials.

Provide Guidance on Taking Photos When Using a Survey App

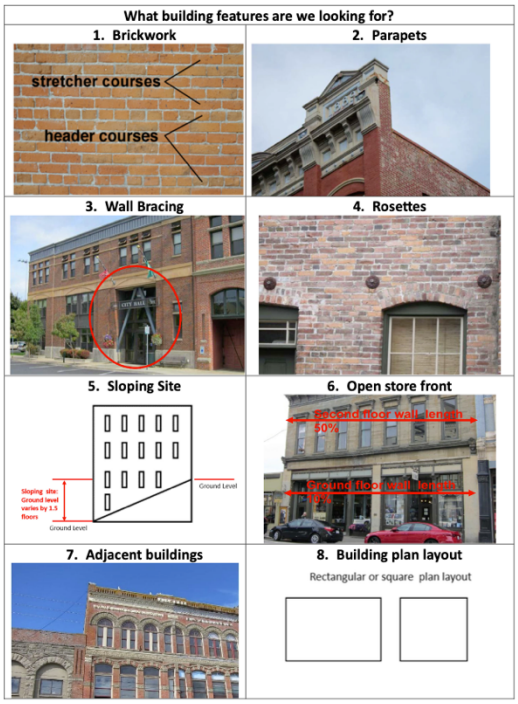
If volunteers will use an app such as Survey123 to collect data during the survey, they will be uploading photos of each building as a whole as well as closeups of particular features. In general, the more photos the better; however, uploading a lot of photos while in the field can be slow, so during the training session, consider reviewing which angles and features the app will prompt them to photograph and encourage them to limit the number of photos they upload for each prompt. Also, explain any procedures they should follow in order to make sure photos will be properly labeled and attached to the data record of the building being surveyed.

Present Guidance for Surveying URM buildings

Show volunteers/surveyors how to recognize an unreinforced masonry (URM) building, as well as any other seismically hazardous building types included in the survey. This includes a presentation of building features that typically appear in a URM structure, such as header courses in a brick wall. Draw particular attention to the features that surveyors will be required to note and photograph as they collect data.

The training presentation ought to include:

- Illustrated examples of typical URM features.
- Illustrated examples of any variations or less common URM features that surveyors are likely to encounter.
- Examples of features that might be mistaken for URM. (Explain how to tell them apart.)



It is also helpful to provide copies of these examples in a reference packet that volunteers can consult as they conduct the survey.

For surveyors with professional experience, this part of the training may simply be a review. Nevertheless, it is an essential part of the training, as it ensures that all surveyors understand precisely what data the survey was designed to collect, how terms are defined, and what surveyors should focus on. This guidance will lead to more consistent results, as all survey teams will operate the same way in the field.

The "8 URM Features" handout (left) provided to survey participants as part of their training for surveys in Everett and Tacoma Washington. (PDF: Washington State Emergency Management Division)

Coach Volunteers on How to Communicate with the Public

Every survey team is likely to be approached by people who are curious about what they are doing, so it is vital that volunteers receive guidance about what to say. Giving volunteers a few talking points and resources to share will ensure consistency in what is communicated and allow volunteers to return quickly to their survey work.

Be prepared to provide volunteers with:

- Talking points. Coach volunteers about what to say and where to direct people who have questions.
- Printed copies of an official letter, one-pager, or card explaining what the surveyors are doing and why (see *Appendix A* for an example of a letter), and providing an official contact (phone number or email address) for any inquiries. Volunteers can give a copy to anyone who asks questions. If an informational webpage has been created for the survey, consider providing a printed QR code that volunteers can share.

It may also be helpful to offer volunteers basic guidance or training on conflict avoidance.

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Who Will Present the Training?

The training and orientation may be presented by one person or divided among several; for example:

- A member of the planning team, such as the "point person" at the lead agency for the survey, may present survey-day orientation information, including:
  - A brief review of why the survey is being done and what the priorities are.
  - Logistical details (assigning people to survey teams, explaining where and when to meet, providing emergency contact information and procedures, reviewing what is in the training packet, and so on).
  - Public relations guidance and talking points (what to say or do if questioned by building occupants or other members of the public about the survey).
- A structural engineer or related subject-matter expert is the obvious choice to prepare and present training on identifying unreinforced masonry (URM) buildings.
- The planning team member or staff person who assembled data about the survey area and set up the app/survey tool may be the person who explains to volunteers how to input information about the buildings they survey. If using Survey123, this presenter might be a GIS specialist.

An engineer with the City of Tacoma presents training on the first day of Tacoma's URM survey. Photo: Washington State Emergency Management Division.

How Will the Training Be Delivered?

Assembling volunteers/surveyors to receive training and orientation in person helps to ensure consistency when teams go out to survey buildings and input their observations. It also provides an opportunity for participants to ask questions and request clarification.

If the survey is to be done on a single day, a simple model is to schedule the training to take place on the same day. For example, volunteers assemble in a meeting room where they:

- Sign in
- Are given their team assignments.
- Receive training and orientation, concluding with Q&A.
- Borrow safety vests (etc.) for use during the survey.
- Form teams and receive a survey packet.

Volunteers in Everett, Washington, listen as the trainer demonstrates how to survey an unreinforced masonry building. (Photo: Washington State Emergency Management Division)

Depending on the meeting location and number of volunteers, it may be helpful if the trainer takes the volunteers outside in order to survey a nearby building and show how to input the data into the app/survey tool. If this isn't practicable, consider setting up a test/practice option that volunteers can go through by themselves during the training session so that they can practice entering data and uploading a photo.

Once orientation and training are concluded, survey teams disperse to begin surveying their assigned areas.

Rehearse the Survey and Training Session

Prior to delivering the orientation and training, the planners, presenters, and trainers should meet to:

- Test the functionality of the survey app or tool. This should be done far enough in advance of the survey to leave time to fix glitches and delete any test data entries.
- Share and practice the orientation/training presentations. This reveals any gaps and allows the group to adjust the timing to keep everything running smoothly and on schedule on the day of the survey.
- Confirm that all necessary equipment (projector, screen, laptop, etc.) is assembled and will work in the room where volunteers will meet on the day of the survey.
- Finalize training presentation slides in time to prepare a PDF (if planning to offer a digital copy).

Supplemental Training Videos

Another option is to prepare a training video on how to identify unreinforced masonry buildings. This can be provided to volunteers prior to the date of the survey so that they can preview and study the examples at their own pace. A video is best treated as a supplement to the in-person training, as without a means of tracking whether volunteers watch and study the video, the planning team cannot gauge whether all participants are equally well prepared to survey buildings. Unequal preparation could affect the quality and consistency of the data collected.

A Training Slide Deck and Video for Statewide Use

To help small jurisdictions and ensure consistency, a state agency could create a model training slide deck and a training video to teach users how to identify unreinforced masonry buildings and/or other seismically dangerous building types in the state. The slide deck and video can then be shared with any jurisdiction in the state to assist with training volunteers/surveyors.

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Prepare and Provide Survey Packets

Provide each team of volunteers with a survey packet, which provides logistical information for the day of the survey, a map showing the buildings and blocks in the team's assigned survey zone, definitions of terms used in the app/data-collection tool, and illustrations/photos of various examples of the features that indicate a building is likely to be an unreinforced masonry (URM) structure. These features will have been presented during the in-person training session; the examples in the packet may include both common features and variants, so volunteers can compare what they see in the field to a range of examples whenever they are uncertain.

While each survey team should receive a binder to carry with them into the field, it may also be helpful to provide a PDF of the contents of the packet for those who prefer to access it digitally.

What to include in or with each survey team's binder:

- Safety information (on the front or back of the binder), including:
  - Emergency contact information
  - Safety guidelines
  - Technical support person's contact details
  - Address where teams should go to check in when they finish for the day
- A QR code to the survey app (if using Survey123 or other online data-collection tool)
- A paper back-up copy of the digital survey

- Definitions of terms used in the survey
- Photos of various building features that indicate that a building is unreinforced masonry
- A color-coded map of the sector/blocks that the team is assigned to survey
- Communications materials for distribution to members of the public who approach survey teams and ask what they're doing; for example:
    - Copies of a letter or one-pager explaining the survey and providing a contact for more information
    - A printed QR-code linking to an informational webpage
- Pencil or pen

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Section 3. Plan Survey Day Logistics

Assign Roles to Planning Team Members

In addition to identifying who will facilitate the orientation session and present the training, determine who will:

- Be the safety coordinator/emergency contact for the day.
- Make sure all volunteers have signed in and been assigned to a survey team.
- Distribute the survey packets/binders to each team.
- Be responsible for managing set-up and clean-up of any refreshments served.
- Stay in a base-of-operations room to:
    - Monitor the progress of the survey.
    - Respond to volunteers' phone calls.
    - Help troubleshoot any problems.
    - Provide technical support.
    - Make sure returning volunteers/surveyors sign out.

Establish the Survey's Starting Point

Reserve a meeting room that is:

- Large enough for participants to assemble and receive the pre-survey orientation and training.
- Equipped with A/V equipment (such as a screen, projector, microphone, and speakers) for the orientation and training presentations.
- Within easy walking distance of as much of the survey area as possible.
- Available to serve as a base of operations/communications-hub during the survey.*
- Accessible to volunteers/surveyors returning to check in at the end of the survey day.*

**If using a space other than the initial meeting room to serve as a base of operations and check-in point, be sure to communicate to volunteers where it is so they know where to go when they are done for the day and ready to sign out.*

Tell Participants What to Bring

The coordinator of the survey may be able to provide a few of the following items (such as the vests) for volunteers to use on the day of the survey; otherwise, ask volunteers to bring their own:

- Cell phone
- Portable cell-phone charger/power backup (if using a cell phone to take photos and run a survey app)
- High-visibility vest
- Refillable water bottle
- Clothing suitable for the weather
- Protective gear, if needed for the conditions (e.g., hat, sunscreen, or rain gear)
- Public transportation pass, if on a team that will use public transportation to reach a survey area some distance from the place where volunteers meet for training.

Be prepared to provide:

- Name tags (and lanyards, if needed)
- High-visibility vests
- Bottled water

Note that providing matching high-visibility vests and printed name tags that formally identify volunteers/surveyors as participants in the survey can help to lend legitimacy to what they say when they answer questions from building owners and the public.

Consider Providing Backup Equipment

In case volunteers forget to bring or have problems with their own cell phones, the planning team may want to have a few extra cell phones on hand for volunteers to use. Likewise, having a few backup batteries or mobile charging devices may be helpful in the event that volunteers' cell phone batteries drain before they can complete their survey blocks.

Anticipate Battery Usage

If participants will be using their cell phones to access Survey123 (or another app), take photos, and enter the data they collect, be advised that 2 to 3 hours of this usage can drain a cell phone battery, which may force volunteers to quit before they finish surveying their assigned buildings. If possible, provide each survey team with a portable backup battery or charger; or ask volunteers who own one to bring it.

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Divide Participants into Survey Teams

Prior to the day of the survey, review the list of registered participants and assign each person to a survey team. For both efficiency and safety, it is best if each survey team consists of at least two people.

If the group conducting the survey will include both experienced and inexperienced volunteers, consider creating survey teams that pair experienced volunteers/professionals (e.g., engineers, building inspectors) with volunteers who have no prior experience.

Plan Security/Emergency Protocols

Safety Equipment

Every volunteer should wear a high-visibility safety vest while out conducting the survey. Some volunteers may be able to bring their own; however, the survey planning team should be prepared to provide vests to volunteers who either don't have one or forgot to bring it.

Safety Protocols

Recommended protocols include:

- A sign-in/sign-out sheet for volunteers so that the safety coordinator knows who is out surveying and when they return.
- Providing volunteers with a safety/emergency contacts sheet and brief instructions on what to do and who to call in the event of an emergency or other difficulty. (See in addition *Appendix A* for an example of safety guidance.)

Consider Other Needs

Offer Refreshments

If funds permit or a sponsor can be found to cover the costs, serving breakfast or lunch to volunteers/surveyors when they assemble for training on the day of the survey is a good way both to encourage attendance and thank people for their participation.

Water

- Remind participants to bring their own refillable water bottles; provide access to drinking water at the place of assembly.
- Have some bottled water on hand to distribute to those who need it.

Identify Transportation Needs and Options

If any areas of the survey are not within walking distance of the place where volunteers/surveyors will assemble:

- Determine which teams will require transportation.
- Identify transportation options: for example, carpooling or public transportation. If using the former, make sure teams know their parking options; if using the latter, make sure team members have the requisite public transportation pass. Consider whether and how volunteers will be reimbursed for parking fees or transportation passes/tickets.
- When estimating the number of buildings volunteers will be asked to survey, factor in their driving time to and from their survey areas.
- Have a contingency plan for problems such as a car breakdown.

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Section 4. Prepare for Data Collection

Decide What Data to Collect

Ask About Existing Criteria

Ideally, the particular kinds of data that the survey planning team designs the survey to collect will already have been defined at the state level. Having statewide criteria simplifies the survey planning and development process for local jurisdictions and ensures that data collected anywhere in the state will be complete, consistent, and adequate for the purposes of applying for mitigation grants.

In the state of Washington, for example, the state Emergency Management Division has developed a "data dictionary" for unreinforced masonry (URM) building surveys. This not only streamlines the survey planning process for local jurisdictions, it ensures that data collected will be ready to upload into the state's URM database, which is hosted by the state Department of Archaeology and Historic Preservation. (See *Appendix B*.)

If no statewide criteria exist, consider asking other jurisdictions that have already done URM surveys to share the specifics of what they designed their surveys to assess and record.

What to Consider When Setting Up a Survey App

First and most importantly, it is necessary to decide in advance exactly what data will be collected, what terms will be used, how the data prompts will be stated for each data field, and what the options are for responding to each prompt. **This schema or "blueprint" of the survey should be finalized before the survey app is set up**. Altering the app domains once the survey is built can cause technical problems.

Survey123 App Customization

Smaller jurisdictions may find it easier and more cost-effective to develop survey criteria that they can share. They may also set up a survey app together. For example, once the Survey123 app has been set up to prompt users to enter responses and upload photos during a URM survey, it may be used by other jurisdictions if they customize it by substituting certain layers, namely:

- The map layer that displays their search zones.
- The map layer showing the buildings themselves.
- The layers of data points that will prefill certain fields (address, date of construction, etc.) in the survey form.

It is also recommended that the planning team and the GIS/app specialist:

- Make sure terms used in the app/data-collection tool and terms used in the training materials provided to volunteers are consistent.
- Create survey prompts (data fields) that require volunteers/surveyors to choose from a limited selection of responses: for instance, select "yes" or "no," select one or more multiple-choice option, or select one or more items in a drop-down menu. This is preferable in most cases to asking volunteers to fill in a free-form text field, which can result in inconsistent and ambiguous data.
    - Consider including one free-form text field at the end for general notes to capture any observations that fall outside of predefined options.
- Prepare the app to label uploaded photos and attach or associate them with the data record of the particular building being surveyed; then, detail any protocols that volunteers/surveyors will need to know when taking and uploading photos during the survey.
- Prior to the date scheduled for the survey, go outside and test the app in the field by using it to perform a survey of a building.
- Incorporate test/practice data points or set up some other procedure that will allow volunteer surveyors to go through a "test" case in the app during their training so that they can see first-hand how it works.

In addition, **it is recommended that the app be set up for the quality assurance/quality control (QA/QC) review at the same time that it is being prepared for the survey**. Data fields that will be used by the QA/QC reviewers can be hidden from survey participants and turned on later when needed.

Go to **Prepare the Survey for the QA/QC Review** *to learn more.*

Benefits of a Well-Planned Data Structure

The importance of a solid data structure in a data collection application cannot be overstated: it plays a critical role in the overall success and usability of an inventory system. Including someone from the GIS/IT department early in the project planning phase is a smart move that can save significant time and funding in the long run.

Strong data structure is fundamental for:

- **Efficient data storage.**
    - A well-structured approach can reduce storage overhead and potentially lower agency hosting costs.
    - Efficient storage also contributes to smoother data handling and integration.

- **Faster data retrieval.**
    - Preloading existing historical data (such as prior inventories or property records) into the collection system increases workflow efficiency and helps reduce redundant data entry.
    - Proper indexing and relational structuring drastically improve retrieval speed for both field teams and back-end systems.
- **Scalability and analytics.**
    - As data volume grows, poor structuring can lead to lag, system crashes, or data collection failure.
    - Early discussions with the GIS/IT specialist can help the planning team identify the technical possibilities for supporting both data collection and data analytics, which may be useful for sorting or compiling information for other purposes in future.
- **Ease of maintenance and updates.**
    - Establishing the structure early reduces the need for future adjustments to the survey (e.g., Survey123 forms), associated data tables, and backend integrations.
    - Connecting with systems like building permits or property tax records is much easier with a stable structure in place.
    - Software updates or platform changes (e.g., in Survey123, ArcGIS, etc.) can sometimes force workflow changes. Having a flexible and well-documented data structure helps minimize disruption when that happens.

Color-Coding Maps for the Survey

When setting up any color-coded maps (whether in a survey app or printed), be sure that the colors used are easy for people who are color blind to distinguish; alternatively, provide pattern-based identifiers, such as cross-hatching, instead of, or in addition to, color.

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Examples of Survey Data to Be Collected

While some surveys may be planned to include inspection of both interior and exterior features of buildings, this typically requires surveyors to be formally trained subject-matter experts. The survey team must also obtain the building owner's permission before they can inspect the interior. In the case of surveys that look only at the outside of buildings, keep in mind that volunteers/surveyors can only collect data on what they are able to see from the vantage point of a public sidewalk.

It may be possible to pre-populate some of the survey data fields (building address, date of construction, etc.) with information collected during the survey planning process. This will save surveyors time.

- In the case of pre-populated data-entry fields, surveyors should have the option to correct the entry if they can ascertain visually that the information provided is wrong.
- Likewise, some data fields may be corrected or filled in later by quality assurance/quality control (QA/QC) reviewers after the survey is completed, provided that the reviewers have easy access to online data sources that contain the required information.

As they survey a building, surveyors will also be asked to take photos that document both the building as a whole and specific features. The photos not only form part of the future record of the building in the URM inventory database, they give QA/QC reviewers the visual evidence they need to assess the accuracy of the data collected and make corrections if needed.

The following examples of data to be collected are based on unreinforced masonry (URM) surveys in the state of Washington. *(To see screenshots of one such survey, including prompts and data-entry fields, go to* Appendix C*.)*

- **Address of the building.** This data field may be pre-populated, or volunteers may select the address from a drop-down menu.
- **Building status.** For example, volunteers indicate whether the structure is a potential URM building, was demolished, or is obviously not a URM building. The response to this question determines whether the volunteers need to carry on surveying the building.
- **Use of the building.** For example, volunteers indicate whether the building is commercial, office, multi-family residential, emergency, government, industrial, public assembly, school, mixed use, and/or other. If the building is an emergency facility, volunteers may in addition be asked to indicate what kind (hospital, fire station, police station, or other)

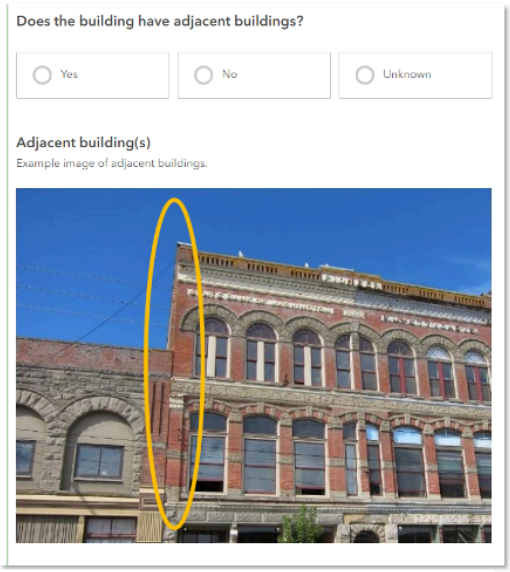
Why Collect Data about "Building Use"?

How a building is used tends to change over time, so why should survey participants collect this data when they survey unreinforced masonry (URM) buildings?

Building use matters from the standpoint of evaluating community risk and estimating potential earthquake impacts and losses. Information about how URM buildings are being used and by whom helps community and emergency planners use the inventory to inform disaster modeling and determine priorities and strategies when developing emergency response plans and seeking funding for mitigation.

- **Building ownership.** Volunteers simply indicate whether ownership is private or public. This data field may be pre-populated; or volunteers may leave it blank to be filled in later by a QA/QC reviewer.

- **Date it was built.** This data field may be pre-populated; volunteers may correct it based on visual evidence, such as a plaque on the building; or they can leave it blank to be filled in later by a QA/QC reviewer.
- **Year of latest seismic upgrade (if any).** This data field may be pre-populated; or volunteers may leave it blank to be filled in later by a QA/QC reviewer.
- **Number of stories above ground.** Volunteers can usually submit a response based on visual evidence. If they are likely to encounter buildings on sloping ground, they will need to be instructed to count the number of stories from the side of the building that has the most stories exposed above ground.
- **Estimated square footage.** This data field may be pre-populated; or volunteers can either estimate it based on visual evidence, or leave it blank to be filled in later by a QA/QC reviewer.
- **Construction material.** Volunteers indicate whether the building is made of brick, concrete block (i.e., concrete masonry unit—CMU), hollow clay tile, stone, or adobe; or volunteers can select other, unknown, or not assessed.
- **Historic status.** This data field may be pre-populated; or volunteers can indicate "yes" based on visual evidence, such as a plaque/historic marker on the facade of the building; or they can leave it blank to be filled in later by a QA/QC reviewer.
- **Architectural features.** Volunteers indicate whether the building contains brickwork, and, if it does, whether it has header courses, window arches or windows with stone lintels, and/or parapets. If it has parapets, and they can see parapet bracing, they can indicate this as well. More likely, they won't be able to see the parapet bracing from the sidewalk, so the QA/QC reviewer should later take a look at aerial images in order to determine whether such bracing is present.
- **Bracing.** Volunteers may be able to see other types of external bracing that reveal that a building has already undergone some seismic retrofitting. The QA/QC reviewer may later be able to confirm or qualify the existence of bracing based on permit records, assuming that reviewers can access these records online.
- **Anchor plates.** Volunteers indicate whether and where they see anchor plates; these commonly appear as rosettes—that is, round or square steel plates indicating that the wall of a building has been anchored to the underlying structure.
- **Sloping site.** Volunteers indicate whether the building is constructed on a slope such that the bottom story of the building is above ground on one side but below ground on the other.
- **Open storefront.** Volunteers look at the street-facing walls of the building and estimate (1) the ratio of windows to walls on the first story and (2) the ratio of windows to walls on the second story. For example, they may estimate that the first-story storefront is 85% windows to 15% wall, and the second story is 50% windows to 50% wall.



Example of a data-entry field from the Survey123 app used by the City of Tacoma (Image: City of Tacoma)

- **Adjacent building(s).** Volunteers may be asked to indicate the presence of another building next to/flush with the building they are surveying. If they answer "yes," they will be asked whether there is a difference in the heights of the two buildings, and whether the floors of the two buildings are at different levels (that is, the floor levels of one building do/don't line up with the floor levels of the other).
- **Building plan.** Volunteers may be asked to indicate the plan/shape of the building (rectangular, complex, or unknown) based on what they can see from the sidewalk; however, a QA/QC reviewer will make the final determination based on aerial images of the building.

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Section 5. Do a Post-Inventory Review

After surveyors have finished surveying and have submitted their data entries and photos, the data should go through a quality assurance/quality control (QA/QC) review. The review is essential for ensuring accurate identification of unreinforced masonry (URM) buildings.

If the surveyors who collected the data were formally trained subject-matter experts (e.g., engineers, building inspectors, engineering interns), this review could be a quick and simple check. If volunteers with informal training collected the data or if additional data will be entered at this stage, the QA/QC review will likely be more involved.

Once the review of a building has been completed, the data for that building can be entered into whatever database the state or local jurisdiction uses to host and maintain the inventory.

Who to Recruit to Do the QA/QC Review

If the survey was done using city or county staff or formally trained interns, the review of the collected data may likewise be done in-house. In the case of the Clark County, Nevada, URM inventory, for example, which extended over multiple years, data collected by student engineering interns was reviewed on a weekly basis by the engineer who supervised them.

In the case of shorter-term surveys for which volunteers or agency staff gather the data, the QA/QC review may be done by volunteers, although the latter must be subject-matter experts (e.g., engineers). After reviewing and, if needed, correcting the data collected by the survey volunteers, the QA/QC reviewers may be asked to input additional information: for example, they may be asked to look at photos of the building and judge whether there are adjacent building floor/roof offsets.

The QA/QC reviewer will confirm (or refute) that the building is correctly identified as an unreinforced masonry (URM) building. If unable to make a determination based on the available data, the reviewer may recommend that a second reviewer look at the entry, or that a closer inspection of a particular structure be done.

Qualified volunteers may be recruited from:

- Local engineering firms.
- The city building department.

- The original survey teams (if team members have the professional credentials to perform the QA/QC review).
- Public agencies in other jurisdictions that are interested in conducting a URM survey in their own communities and may be interested in learning by experience.

Final Check of Collected Data

The data collected from surveys of unreinforced masonry buildings (URMs) in the state of Washington will be housed in a database hosted by the state's Department of Archaeology and Historic Preservation. Before data is submitted to the database, it goes through a QA/QC review and a final check: first, a QA/QC reviewer examines the data collected, makes corrections if needed, fills in any required data fields, and marks the data entry for the building "complete;" second, a representative from the local jurisdiction where the survey took place will do a final check and "sign off" to indicate that the data for that building is ready to be published in the database.

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Planning for the QA/QC Review

The following outline provides guidance on how to plan the QA/QC review using qualified volunteers to review survey data. It assumes that the survey was completed within a short timeframe.

The QA/QC review, including training, can be done virtually, assuming that the survey data was collected by means of an app or comparable online tool, or has been uploaded into a database that reviewers can access. Because reviewers will work from their own desks, any qualified volunteer can be recruited. Moreover, no liability waivers need be signed as no liability concerns arise.

Each reviewer works through their assigned sections on their own, at their own pace, so depending on the number of buildings and the number of reviewers, the review process may extend over a period of weeks.

- Convene the survey planning team to:
    - Decide who to invite/recruit as a QA/QC reviewer.
    - Establish a timeframe for the review. This usually begins with a virtual QA/QC training session sometime after the date of the survey and extends for a number of weeks. Be sure to set an end date that can be communicated to reviewers so they know how much time they will have to complete their assigned sections.
- Prepare an invitation that explains:
    - What expertise is needed.
    - What the reviewer will be asked to do.

    - What training will be provided.
    - The proposed date of the training.
    - The proposed timeframe for the review.
- Set up a means of registering or otherwise keeping track of volunteers who accept the invitation and commit to doing the review.
- If needed, set up a temporary account/log-in for each volunteer so that they can access, review, and edit the survey data.
- Decide who will prepare and present the training. Ideally, this is someone who is both qualified to review the data, and familiar enough with the tools and resources that they can perform an easy-to-follow demonstration while sharing their screen.

How Much Time Does It Take to Review the Data?

Reviewers who participated in QA/QC reviews in Washington state estimated that it took between 5 and 15 minutes to review data entries for a single building. A reviewer's speed tended to increase with practice and growing familiarity with both the app/survey tool and the resources used to check the data.

Prepare the Survey for the QA/QC Review

Reviewers must be able to go through the data entries for each building surveyed to verify or correct the entries and then indicate that the review of that building is complete.

Configuring the survey app/tool for the QA/QC reviewers is best done at the same time that the app is set up for the survey itself. The fields that will be used by the QA/QC reviewers can be hidden from the survey participants and turned on later when needed.

Setting up for the QA/QC review typically includes:

- Creating a temporary account/log-in for each volunteer, if needed.
- Grouping the surveyed buildings into zones or sections that can then be assigned to individual reviewers.
- Setting up/turning on tracking fields in the app so that reviewers can indicate if a data point (building) has been reviewed, who reviewed it, and whether additional review is needed.* Additional review would be needed if, for instance, the QA/QC reviewer is unable to complete the review of a building because the data and photos were insufficient or unclear.
- Setting up the reviewers' app-interface so that they also have the ability to:
    - Easily recognize their own assigned zone/section of buildings.
    - Easily view the data and photo entries for each of their assigned buildings.

    - Correct, if needed, data entries made by the survey volunteers; and fill in fields that the survey volunteers may have left blank.
    - Submit comments at the end to draw attention to other relevant observations or explain why they were not able to complete the review (e.g., due to missing or unclear data).
    - Input their name, initials, or reviewer number when they finish the review so the planning team or host of the inventory database can follow up later if they have questions.
- Establishing a means of automatically removing buildings from the inventory that a QA/QC reviewer determines are not unreinforced masonry structures.

**Both the reviewers and the inventory planning team will need a means of keeping track of which buildings have been reviewed and which have not. One way to provide this is to program the application so that the building data point on the map will change color once the review of that building has been marked "complete." A third color may indicate that the QA/QC reviewer marked it "incomplete" because the building requires further review or examination by a local building expert. Be sure to use high-contrast colors that are easy to distinguish, including by reviewers who are colorblind.*

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Prepare and Present Training for the QA/QC Review

The training may be presented in one virtual meeting to the entire group of reviewers, or in several meetings to small groups of reviewers. The training meeting is an opportunity to:

- Thank the volunteers and briefly introduce the survey, explain how and why it was done, indicate what areas were covered, and articulate the role of the QA/QC review.
- Emphasize that if reviewers are not sure whether a particular building is or is not unreinforced masonry, they shouldn't guess but should instead mark it incomplete and recommend that it be examined again.
- Verify that all reviewers are able to log in to their temporary accounts.
- Explain what is expected of the reviewers and share with them:
    - The information resources that they can use to validate, correct, or fill-in blank data fields in the survey content for a building. For example, reviewers might be directed to a database on the county assessor's website, a historic register, and Google Street View.

    - A list of the data fields in the survey that indicates which are required (must be filled in) and which are optional (can be left blank).
    - A glossary that defines the terms used in the survey.
- Assign survey zones to the reviewers.
- Provide step-by step directions. See, for example, the slide presentation that was used to train QA/QC reviewers for a URM survey in Tacoma, Washington (Appendix D).
- Provide a demonstration. In other words, use screen-share to walk the reviewers through the review of one building in the survey so they can see how the application works and what they are to do.
- Answer reviewers' questions.
- Share the contact details of the person reviewers should reach out to if they have questions or need technical support as they work.

If time permits, consider inviting attendees to review either prepared test points or one of their assigned buildings while remaining in the virtual meeting room so that they can go through the process themselves and ask any questions that arise.

It may also be helpful to create a slide presentation or handout that shows basic, step-by-step directions alongside screen shots of what reviewers will see in the QA/QC application. A PDF of this presentation can then be shared with reviewers at the end of the training meeting to serve as a quick reference guide.

Another option is to schedule a follow-up meeting or "office hours" in a virtual meeting room a week or so after the training so that volunteers have an opportunity to ask follow-up questions after they have logged in and worked through the review of a building or two on their own.

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Three historic buildings in Tacoma, Washington, as seen using Google Street View.

What's Next?

Completing an inventory of unreinforced masonry (URM) buildings is a major accomplishment: take time to celebrate the achievement and acknowledge everyone who contributed to the effort!

Next steps will likely depend on the jurisdiction's primary purposes for conducting the survey, as well as whatever plans for using the data were identified by the planning team at the beginning of the survey process. In addition, consider the completion of the inventory to be an opportunity to:

- Publicize the accomplishment. Use this occasion to draw attention to the earthquake hazard and the reasons for identifying and retrofitting seismically vulnerable buildings.
- Discuss with building owners their risks and mitigation options.
- Identify and publicize existing funding sources that can be used to help local building owners finance mitigation projects. These sources may include federal or state grants as well as loans (such as loans available in some states through CPACE programs).
- Inspire others to plan similar surveys in their own communities. Share with other jurisdictions everything that the planning team accomplished and learned.

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Appendices

The following appendices can be accessed on CREW's website, where the contents may be viewed or downloaded for free: crew.org/urm-survey-guide-appendices/

Appendix A. Examples of Documents

1. Letters to send to property owners prior to the survey and to share with building occupants and members of the public who ask questions during the survey:
    a. Example from Clark County, Nevada
    b. Example from Everett, Washington
    c. Example from Tacoma, Washington
2. Safety-guidelines for survey participants (example from Tacoma, Washington)
3. Polling questions to ask survey participants when they finish surveying buildings (example from Everett, Washington)
4. URM-features handout (Washington State Emergency Management Division)

Appendix B. Example of a Data Dictionary

Washington State Emergency Management Division and the state Department of Archaeology and Historic Preservation (DAHP) developed a "data dictionary" to define terms and provide a blueprint that communities in Washington can use when they survey unreinforced masonry (URM) buildings. The dictionary ensures that data collected by each community will be consistent and aligned with the statewide database.

Appendix C. Excerpts from a Survey App

These slides show each step in the Survey123 app that the City of Tacoma set up for a URM building survey on November 15, 2024; the slides were used to train survey participants.

Appendix D. Example of a QA/QC Training Presentation

The City of Tacoma used these slides to train volunteer building professionals to do a quality assurance/quality control (QA/QC) review of data collected during a survey of URM buildings.

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