How to Complete Data Input Documentation for Structural Tornado Damage to Historic Buildings for the Nashville, TN 2020 Tornado (and other Tornadoes)

Introduction

This document provides a detailed, step-by-step guide for completing the data input documentation for historic buildings potentially impacted by the 2020 tornado in Nashville, TN. It can also be applied to other tornado events. The guide is designed to clarify the process of correctly entering data, ensuring consistency and alignment among all research assistants regarding where and how information is sourced and recorded. While the initial process of gathering and inputting data for each building will take approximately one hour, it will become more efficient as researchers become familiar with the procedure.

Additional Information

- All measurements should be in meters (m)
- Yellow highlighted words indicate the software, websites, or resources used for that step
- Most steps will explain how to find and fill the information for each column in the format:

Column Name (Column)

Note: Columns with ** in front of them in the instruction set need uncertainty highlights that go along with uncertainty columns (to the right of their respective column). These correspond with how certain you are of the input in the cell that you have put. These column headers should also be **highlighted in green in the dataframe.**

Colors and their corresponding certainties:

Green – very certain/>75
% certain (3)
Red – somewhat/35-50% certainty (2)
Yellow – very uncertain/0-25% certainty (1)

AH	AI	AJ	AK
construction_type_u	construction_type_u_unc	mwfrs_u_wall	mwfrs_u_wall_unc
masonry_un	2	wall_diaphragm_wood	3
masonry_un	2	wall_diaphragm_mason	2
un	1	wall_diaphragm_stone	3
masonry_un	3	wall_diaphragm_stone	2
masonry_un	3	wall_diaphragm_mason	3
masonry_un	3	wall_diaphragm_mason	3

Necessary Resources and Documents

- Computer
- Computer Applications/Websites
    - Microsoft Excel
    - Snipping tool/screenshot on your computer
    - Access to project One Drive: **2024_Shayla_Gianna_PSU**
    - Google Earth Pro (downloaded to computer)
    - Google Maps online: https://www.google.com/maps
    - Fulcrum online: https://web.fulcrumapp.com/users/sign_in
    - Zillow: https://www.zillow.com/
- Necessary Document
    - "Minimal Building Fragility Portfolio for Damage Assessment of Communities Subjected to Tornadoes": https://doi.org/10.1061/(ASCE)ST.1943-541X.000204

Troubleshooting and Follow-Up Advice

- **Access Issues:** If you do not have access to the One Drive, contact Yishuang Wang or another research assistant to provide you the access and rights to the One Drive folders.
- **Unclear Information:** If you're uncertain about any data (such as the building's year of construction or the archetype), make a note in the "notes" column. Research may require further investigation or assumptions based on available data. Feel free to ask for any structural clarifications.
- **Missing or Incomplete Data:** In cases where data is unavailable (e.g. year built, occupancy), input "un" as a placeholder, standing for unknown.
- **Photo Documentation:** Ensure that all photos are taken both before and after the tornado to provide clear visual comparison. If you have trouble accessing street view photos from Google Maps, try adjusting the timeline to get a more accurate representation. If any particular view cannot be found in any manner, note this in the "notes" column at the end of the dataframe.

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Opening the Excel document

1. Open the One Drive link: 2024_Shayla_Gianna_PSU
   - You will see various folders.

data_input > Nashville_Tornado_DataInput_Gianna.xlsx

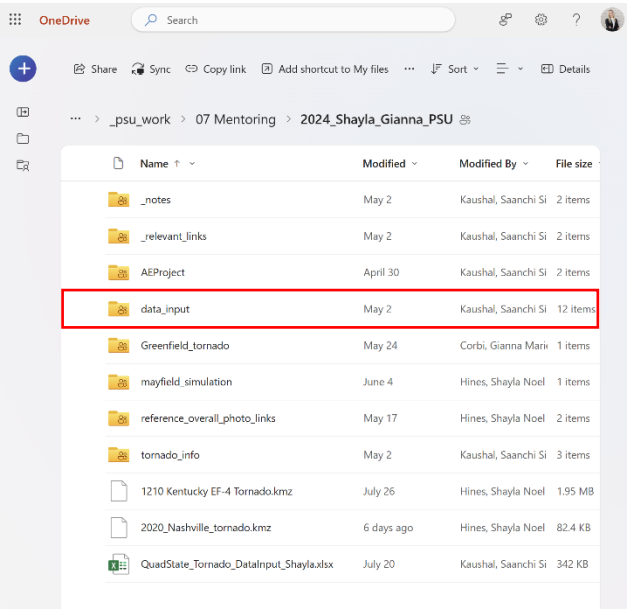


Figure 1

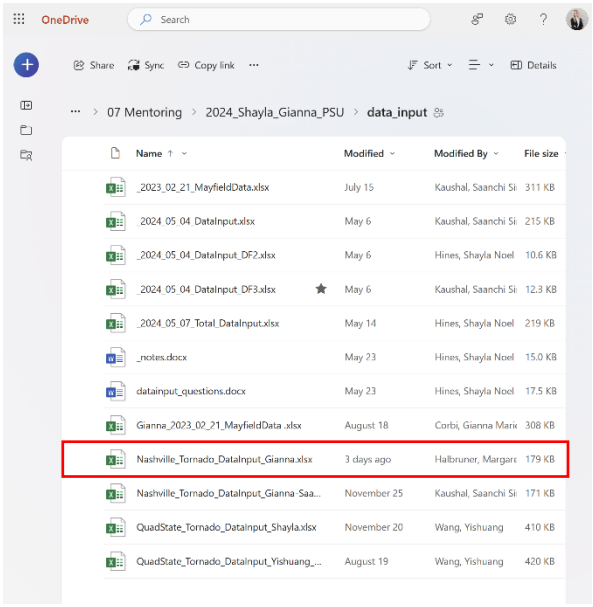
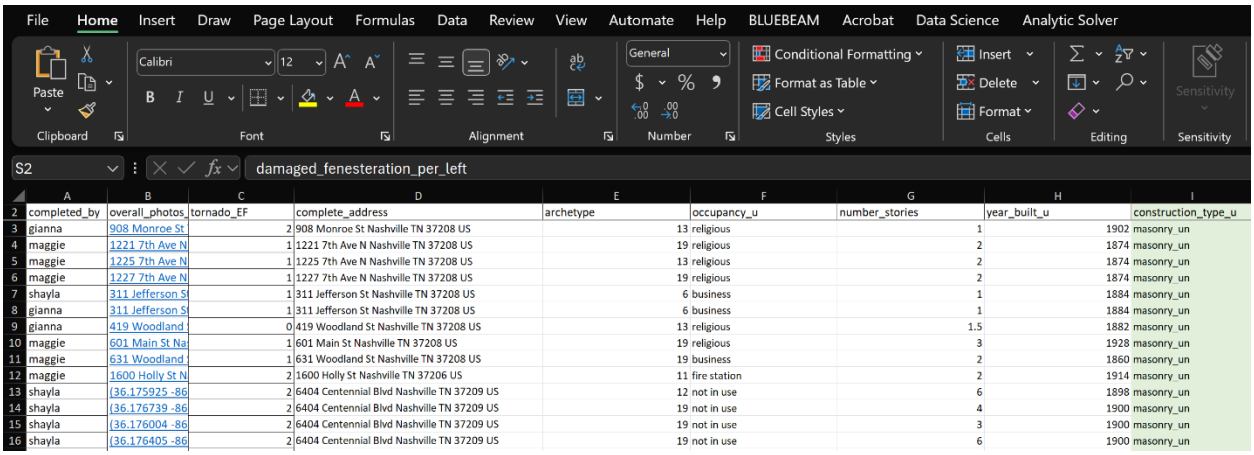


Figure 2

2. This Excel spreadsheet is the main database for the information dataframe. Once you open this file, you will see a list of addresses added by another on the research team. These are all of the buildings which will need data collected, for columns A-U, which will be explained below.



	A	B	C	D	E	F	G	H	I
2	completed_by	overall_photos	tornado_EF	complete_address	archetype	occupancy_u	number_stories	year_built_u	construction_type_u
3	gianna	908 Monroe St	2	908 Monroe St Nashville TN 37208 US	13	religious	1	1902	masonry_un
4	maggie	1221 7th Ave N	1	1221 7th Ave N Nashville TN 37208 US	19	religious	2	1874	masonry_un
5	maggie	1225 7th Ave N	1	1225 7th Ave N Nashville TN 37208 US	13	religious	2	1874	masonry_un
6	maggie	1227 7th Ave N	1	1227 7th Ave N Nashville TN 37208 US	19	religious	2	1874	masonry_un
7	shayla	311 Jefferson S	1	311 Jefferson St Nashville TN 37208 US	6	business	1	1884	masonry_un
8	gianna	311 Jefferson S	1	311 Jefferson St Nashville TN 37208 US	6	business	1	1884	masonry_un
9	gianna	419 Woodland	0	419 Woodland St Nashville TN 37208 US	13	religious	1.5	1882	masonry_un
10	maggie	601 Main St Na	1	601 Main St Nashville TN 37208 US	19	religious	3	1928	masonry_un
11	maggie	631 Woodland	1	631 Woodland St Nashville TN 37208 US	19	business	2	1860	masonry_un
12	maggie	1600 Holly St N	2	1600 Holly St Nashville TN 37206 US	11	fire station	2	1914	masonry_un
13	shayla	(36.175925 -86	2	6404 Centennial Blvd Nashville TN 37209 US	12	not in use	6	1898	masonry_un
14	shayla	(36.176739 -86	2	6404 Centennial Blvd Nashville TN 37209 US	19	not in use	4	1900	masonry_un
15	shayla	(36.176004 -86	2	6404 Centennial Blvd Nashville TN 37209 US	19	not in use	3	1900	masonry_un
16	shayla	(36.176405 -86	2	6404 Centennial Blvd Nashville TN 37209 US	19	not in use	6	1900	masonry_un

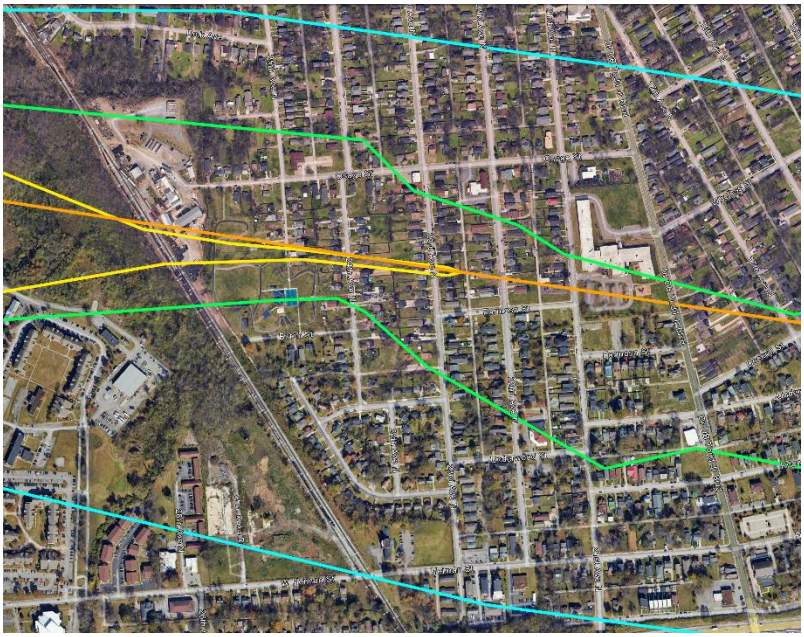
Figure 3

CAUTION: Make sure that the Excel document is on AutoSave so that no or minimal data is lost if an error were to occur and close the file unexpectedly.

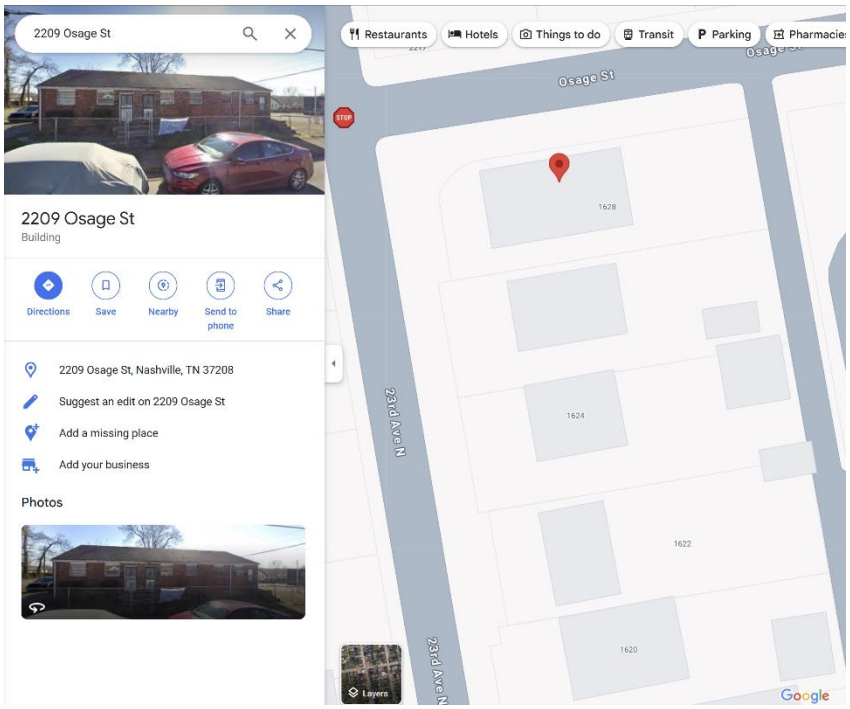
Finding Historic (Masonry) Buildings

Before beginning to complete data input, it is first best to decide which areas and buildings you are going to be looking at. Here are the steps I suggest to get started:

1. Determine which tornado path you are looking at (if there are multiple paths).
2. Find or have someone create a KMZ file to import into Google maps that shows the tornado path, along with all of its contours (to show the boundaries).
3. Now for the very time-consuming part, you will need to go area by area, street by street to pick out the buildings and addresses which will need to be listed in the dataframe. You will need to cross-reference: Google Earth Pro, Google Maps, and Zillow. Some steps include:
    a. Pick an area to look at (as shown below). I like to take screenshots and import it to my iPad so I can highlight and mark off where I have and haven't looked at. **Note: I try to pick sections of the path that I can easily section off and keep track of as I go along the path; you'll want to start from the very left of the path, moving right.**



4. Then, go through **every street and building,** looking for historic masonry buildings. As of right now, we're defining historic buildings as anything built 1949 and before. This will require some prior knowledge of what historic masonry buildings look like.
5. Once you have found a building that is historic, add the address to the list of buildings in the Excel sheet **(under the address column)**.
    a. Looking at the building on Google Maps can show you the address (building number) in aerial view.
    b. If you're uncertain about if it was built in 1949 or prior, you can use either Google searches or Zillow to find the year it was built.



S.No. (A)

This cell will remain empty.

completed_by (B)

All that is needed in this box is your name to indicate who completed the information for this building – e.g. maggie, shayla, gianna.

fully completed? (C)

Complete after everything is completed. Use a "Y" to indicate that the entire row is done for that building, including all information and checking Fulcrum for all damage statuses.

how was it found? (D)

Different inputs:

- NRHP – The building is on the National Register of Historic Places
- visual historic masonry – Picked out from looking at all buildings in the tornado path.

historic registered building? (E)

It is on the National Register of Historic Places? Either "yes" or "no".

tornado_name (F)

Typically what has been used is “Month Day, Year Tornado Outbreak” and is same for all buildings because there should be s different data set for each individual natural disaster being looked at.

e.g. March 3, 2020 Tornado Outbreak

tornado_year (G)

Year for the tornado; should be the same for every building in the data set.

town (H)

Based on the address (e.g. Nashville).

overall_photos_link (I)

Note: This column can be done at any point in the process, before, during, or after completing the other columns.

You want to include photos of all sides of the building, before and after, and aerial views.

These are the photos that should be collected for each building and how they should be labeled (if able to be found):

- **front_before**
- **back_before**
- **right_before**
- **left_before**
- **aerial_before**
- **front_after**
- **back_ after**
- **right_ after**
- **left_ after**
- **aerial_after**

Note: If

How to generally get these images:

1. Go back to Google Maps street view where the building is. Take a screenshot/snipping tool of each side of the building both before and after the tornado.
    a. In the top left where the address is shown (still on street view), click “See More Dates” to change the timeline of the imagery (see Figure 4 below).

b. Make sure to get front, back, left, and right from before and after

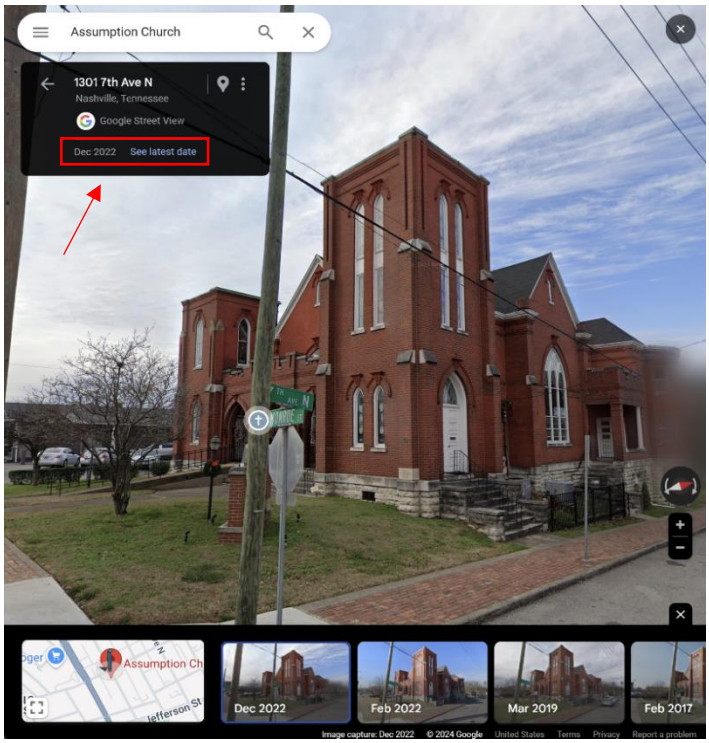


Figure 4

2. In Google Earth Pro, take screenshots of the aerial views before and after.
    a. Click the "Historical Imagery" button on the top row, as pictured in Figure 5, to change the dates of the imagery to find the closest before and after.

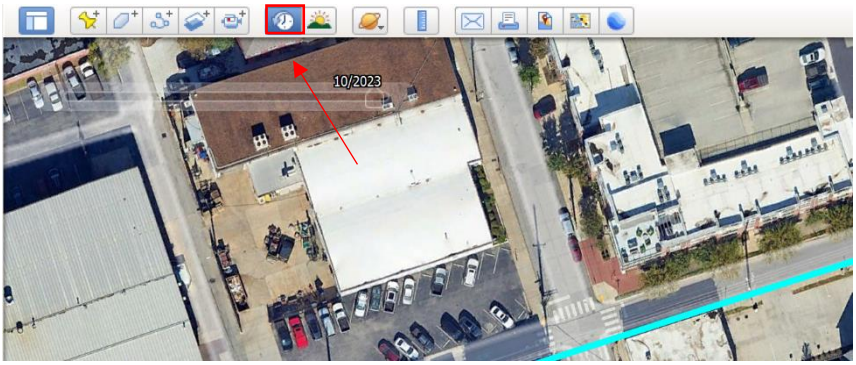


Figure 5

3. Take screenshots of all photos listed within Fulcrum for the building, to show more damage in depth.

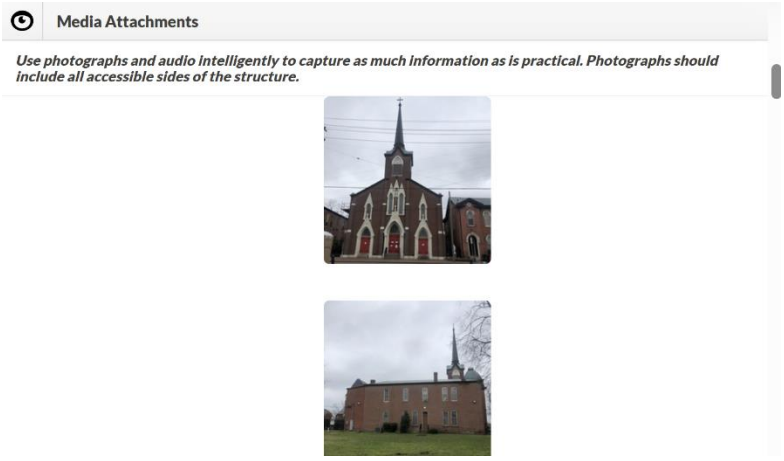


Figure 6

4. Once all screenshots and photos have been collected, open the photos folder on the One Drive.
    a. Open the 2024_Shayla_Gianna_PSU > reference_overall_photos_link > Nashville_2020_Tornado_Photos
5. You will see various addresses listed. Add a new folder for the building:
    a. Blue plus button in the top left corner > Folder
    b. Enter address for the Name and press create

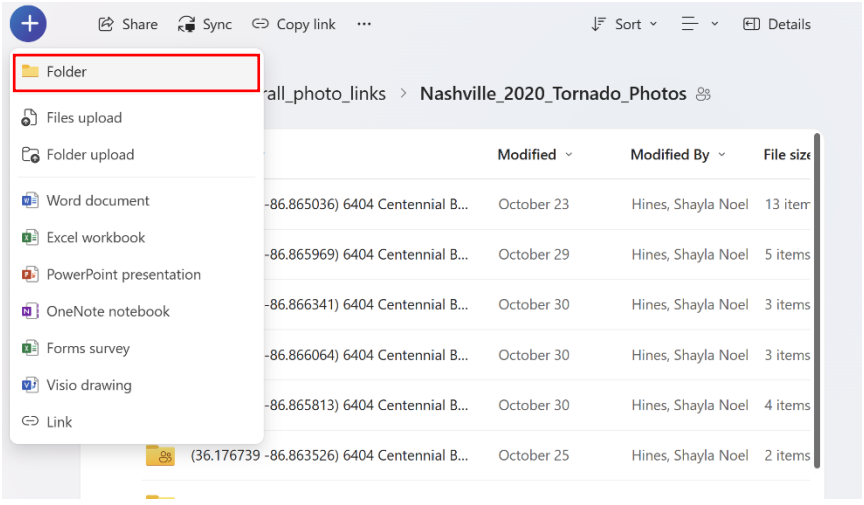


Figure 7

6. Finally, open this new folder and add all of the photos collected by dragging and dropping from their location on your computer.

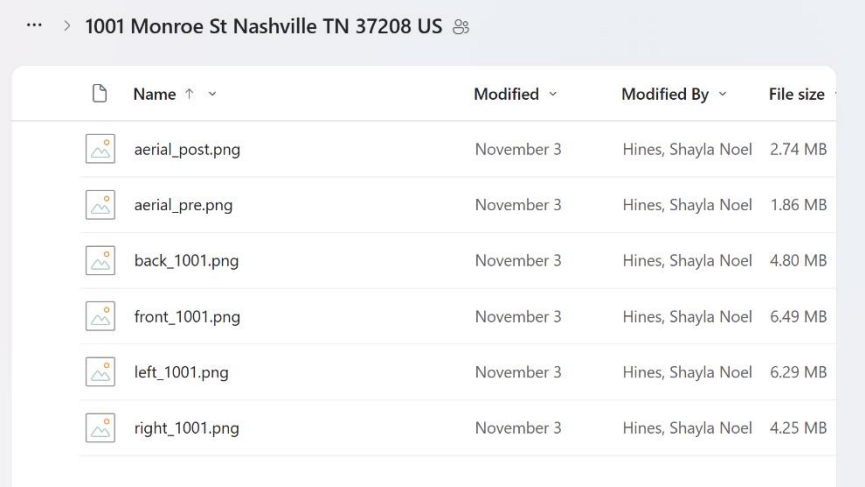


Figure 8

7. Go back to the main folder with all of the building subfolders.
8. Right click your correct file folder > press “Copy Link” > paste this into the correct cell in the Excel dataframe.

tornado_EF (J)

1. To figure out the tornado EF value, you first need to download the KMZ tornado path from the One Drive (Figure 9) and import it to Google Earth Pro: 2020_Nashville_tornado.kmz

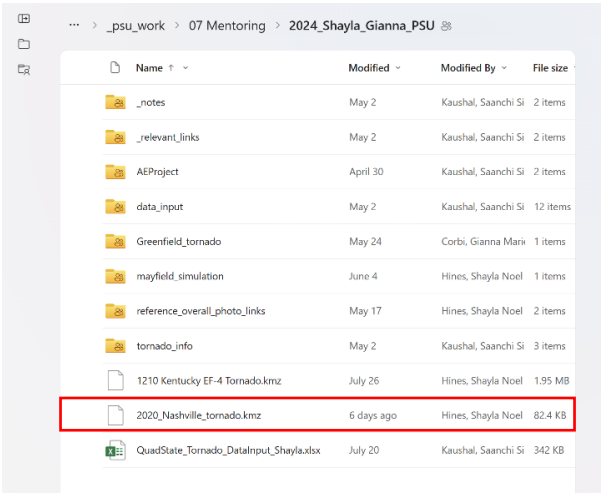


Figure 9

2. With Google Earth Pro open, you will see the different tornado EF contours.
3. If you click where the building is located, an information box will show up showing “EF #”, with numbers ranging from 0 to 5, as seen in Figure 10.

4. Add this number to the entry box in Excel, **just the number (no EF).**

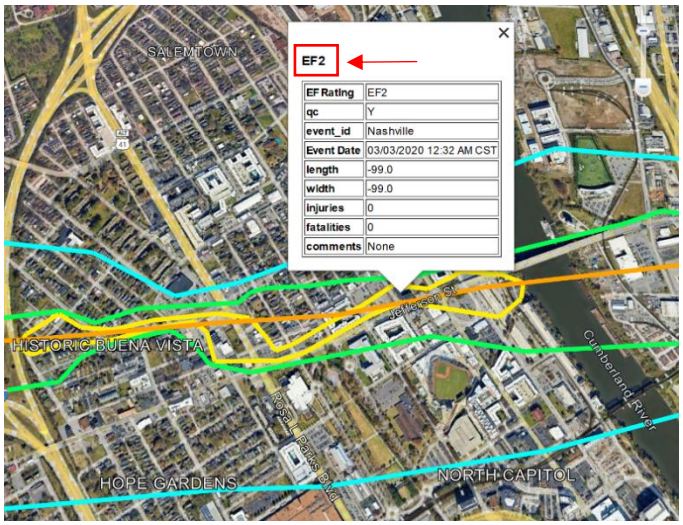


Figure 10

tornado_start_lat – tornado_end_long (K-N)

These coordinates are based on the closest tornado path for each building. Depending on the tornado, this could be the same for all buildings (there is only one major path) or multiple for the set (there are various tornado paths being looked into).

To find this:

1. Click on the closest main tornado path (will be the one in the middle, NOT the contours).
2. A table of data will pop up for the tornado path, and the numbers will be located by: **startlat, startlon, endlat, endlon (Figure 11).**

Figure 11

Note: Make sure to add the negative signs into the cells (they indicate different directions).

latitude & longitude (OP)

These coordinates are based on the Google Earth Pro location of the building location (in decimal form). There are many ways to find the coordinates but here is one easy way.

1. Use the **yellow pin** located in the top left corner of the tool bar on Google Earth Pro.
2. As shown in Figure 12, a box will pop up showing the coordinates in DMS format.

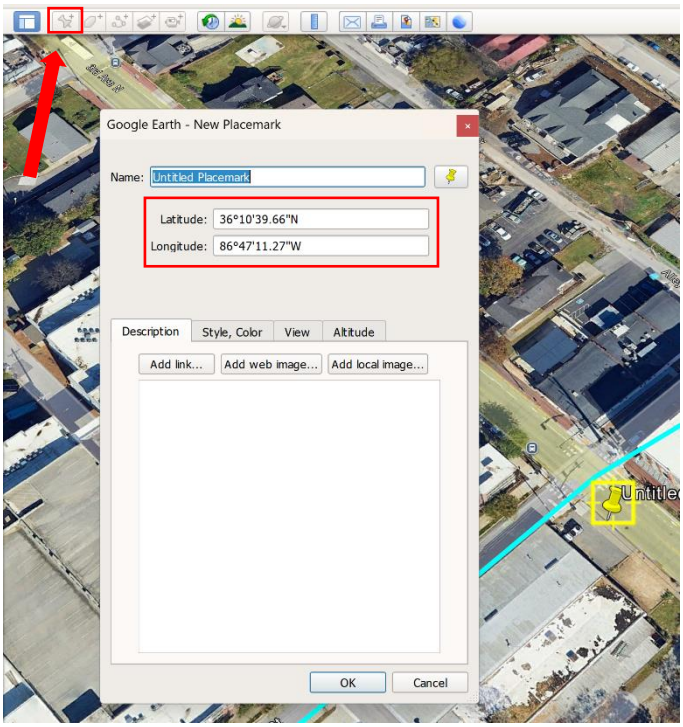


Figure 12

3. To get this number into decimal format, you can use the site Degrees Minutes Seconds to/from Decimal Degrees or any other similar site and input these numbers into the Excel.

Note: North and East will be positive, South and West will be negative

complete_address (Q)

Unless already input, address numbers can typically be found on Google Maps. Include no commas in the address.
e.g. 631 Woodland St Nashville TN 37208 US

Note: Some addresses may not be completely accurate because quite a few very historic buildings don't have exact addresses (coordinates are always the most accurate location).

building_name_listing & building_name_current (R-S)

Unless there is a historic AND current name for the building, you can put the name under the "building_name_listing". Some buildings (residential) will not have a name and that is okay. Leave it blank.

archetype (E)

1. Using the table below, match the building to the best of your ability with one of the archetypes based on the structural makeup of the building. Some assumptions may be necessary as not all structural makeups are obvious.
2. If uncertain for any reason, make any necessary notes in the last column, called “notes”.

Table 2. Details of 12 out of 19 archetype buildings investigated

Building	Number of stories	Footprint area (m^2)	Height (m)	Number of windows	Number of doors	Number of garage doors	Exterior walls	Roof structure	Roof covering
T6	1	2,787	4	300	12	—	Unreinforced masonry	Gable truss	Metal sheathing
T7	2	465	8	20	15	6	Aluminum siding	18K4 steel roof joist	Aluminum sheathing
T8	3	3,716	12	15	10	4	Fully grouted reinforced masonry	18K9 steel roof joist	Built-up roof
T9a	1	13,935	4	75	15	—	Fully grouted unreinforced masonry	Precast concrete roof beam	Built-up roof
T9b	1	9,290	4	60	10	—	Partially grouted unreinforced masonry	Precast concrete roof beam	Built-up roof
T11	1	110	4	8	3	2	Brick wall	Gable truss	Metal sheet
T12	4 and 2	10,220	15 and 8	832	15	—	Glass and unreinforced masonry	Concrete slab	Built-up roof
T13	1	1,394	4	45	4	—	Partially grouted unreinforced masonry	Precast concrete roof beam	Built-up roof
T14	2	8,175	8	150	20	—	Ungrouted masonry infill	Precast concrete roof beam	Built-up roof
T17a	1	68 and 135	4	4	2	—	Wood walls	Gable truss	Asphalt shingles and plywood sheathing
T17b	1	68 and 135	4	5	2	—	Wood walls	Gable truss	Asphalt shingles and plywood sheathing
T18	1	3,716	4	75	10	—	Fully grouted reinforced masonry	26K12 steel roof joist	Built-up roof
T19	1	446	4	15	4	—	Masonry (solid PCL)	Gable truss	Asphalt shingles and plywood sheathing

Figure 13

General Notes: 6 for 1 story brick buildings, 19 for 2+ story brick buildings

located_in_historic_district (U)

Either “yes” or “no”; typically known when it is a very historically recognized building.

occupancy_u (V)

1. The occupancy entry box is for which occupancy best describes the building in its current use (when the tornado occurred). The following options to choose from are:

- assembly
- business
- educational
- factory
- high hazard
- institutional
- mercantile
- residential
- storage
- utilities
- museum
- not in use

For more information on what each one is, look at the 2021 IBC:
https://codes.iccsafe.org/content/IBC2021P1/chapter-3-occupancy-classification-and-use

Note: You may have to do a few Google searches if the use is not apparent and requires a little more digging online.

number_stories (W)

1. Determining the value for this column will be based on visual inspection of the building from Google Maps. To see the building in street view:

a. Open Google Maps
b. Enter the address of the building you are looking at
c. Click and drag the little blue figure in the bottom right corner to the place where the building is, pictured in Figure 14

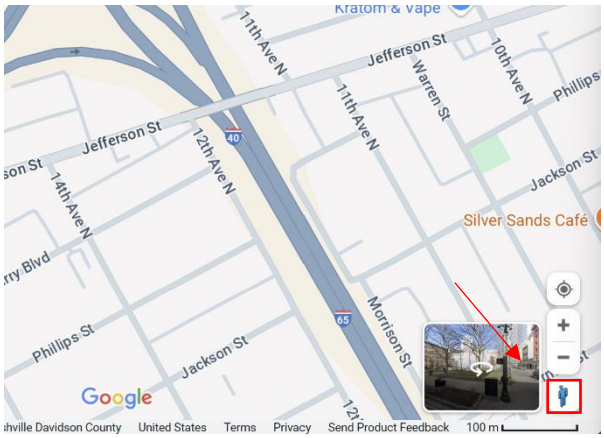


Figure 14

d. Once on street view, you can move around by clicking on the ground

2. Stories will generally be whole numbers, but some residential buildings are input at 1.5 stories.

year_built_u (X)

There are a few ways to tell when a building was built:

1. If it is historic or well-known, online sources may outright say the year that it was built.
2. Some historic buildings may have the year built on the side of the building, which can be seen in street view (as explained in the previous step).
3. Zillow shows the year built for many residential buildings.
    a. Go to Zillow online
    b. Enter the address
    c. Go to the “Home Details” tab under the general information
    d. Scroll down to “Facts and Features”
    e. Year will be listed next to “Year Built:” if available

4. If no year built can be found, just put “un” in the cell

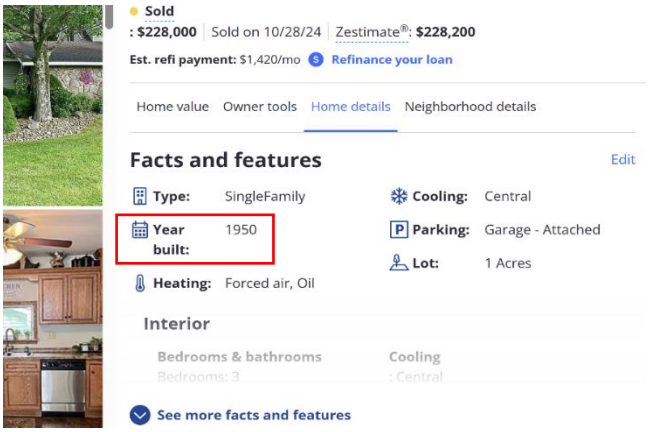


Figure 15

Notes: If given range of years of construction, use the first year; best approximation if ever given a very vague date range.

building_area_m2 (Y)

Find the approx. area of the building using the **Ruler (Polygon)** tool on Google Earth Pro.

1. Go to the **Ruler tool** on the top tool bar.
2. Click on the **Polygon tab.**
3. Click on each corner of the building to create a polygon for the area, where the area will appear in the Ruler tool box (shown in Figure 16).

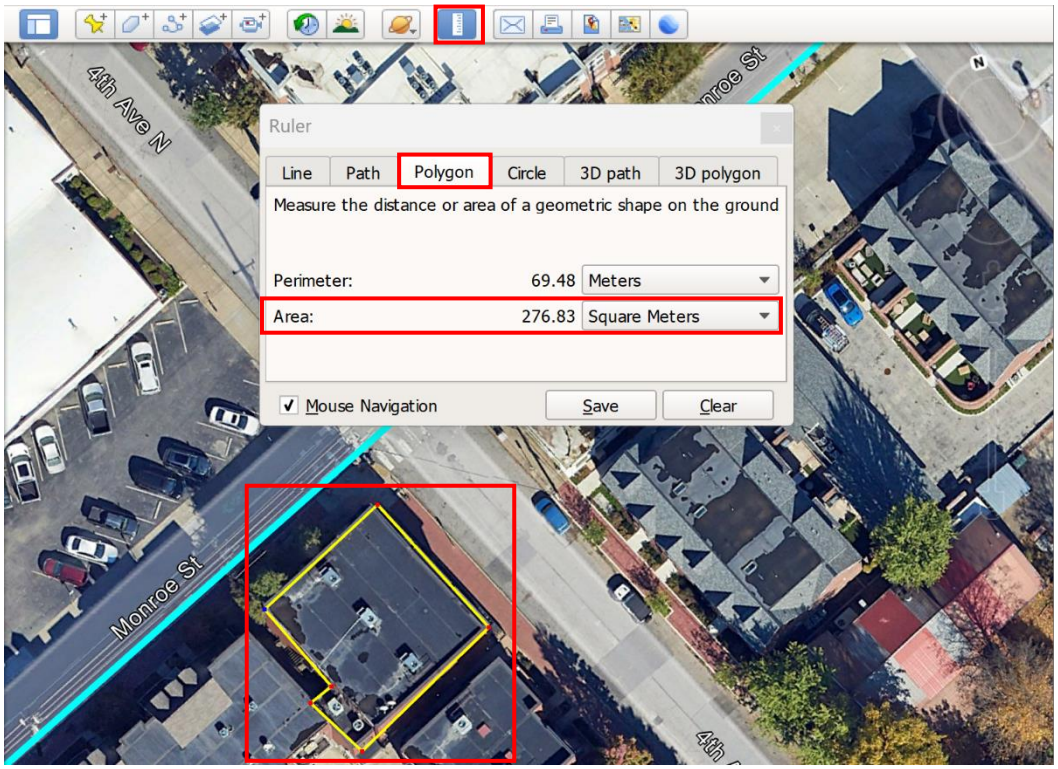


Figure 16

building_urban_setting (Z)

Is the building stand alone of connected (like a downtown row building)? Input options are:

- Isolated
- row_middle
- row_end

building_position_on_street (AA)

Is the building recessed or right on the street? Recessed would be anything with a yard (more applicable when it is in a row of buildings). Input options:

- recessed
- right_on_street

building_height_m (AB)

Best visual approximation upon inspection (on Google Maps/Earth), **in meters**.

Note: It can be helpful to measure based on standard sizes of doors (7') or surrounding buildings.

first_floor_elevation_m (AC)

Again, **in meters**, best approximation upon inspection.

front_elevation_orientation (AD)

Which direction is the front of the building facing? This will be used throughout rest of the data input, as a reference to different sides of the building. Input options include:

- n, s, e, w

Note: If the building is at a 45^{o} angle or similar (not in one specific direction), use the direction closest to the front face. The most important thing is to remain consistent through the entire data entry process.

wall_length_side (AE)

This measurement is the side of the building which is NOT the front!

From length measurement tool on Google Earth Pro

- Ruler > Line
- Click and drag a line for the side of the building that you are measuring
- Either Map or Ground length can be used (since it's an approximation)
- Add this to the Excel sheet

- Don’t include units when putting into the data sheet

Note: Many buildings may not be perfectly or simply rectangular, so it is harder to decide which length to measure. This is up to your discretion (I typically choose the longer measurements).

wall_length_front (AF)

Same as last step, just for the front face of the building.

wall_thickness (AG)

Since we usually can’t see the wall thickness (unless very damaged), you have to put in your best approximation for how thick in meters the walls are. **For typical residential or similar buildings, use 0.2 (assumed).**

roof_shape_u (AH)

Most roof shapes will fall into these input categories (what should be put in the cell):

- flat
- gable
- hip
- gable-hip_combo
- complex
  - anything that has more than one roof shape or not easily classified

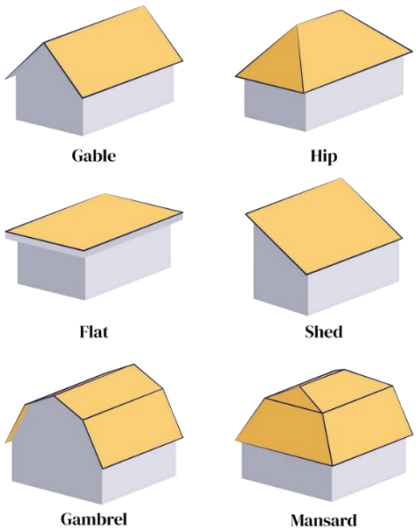


Figure 17

Note: Other shapes are possible, these are just the most common from what we see.

roof_slope_u (AI)

Input options: 0, 30, 45

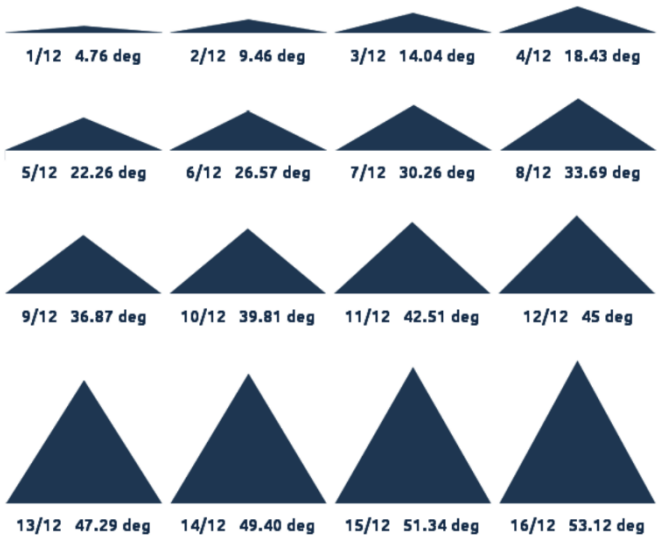


Figure 18

Note: If there are multiple roof slope for the one building, choose which one make up the majority of the building.

**construction_type_u (AJ)

Filling out this cell will require some understanding of what to look for, determining the construction type of a building. Generally, this can be determined by looking at when the building was built (which decade), the outer structural makeup, and the type/occupancy of the building. Prior knowledge on this will be necessary.

The most common choices for data entry in this cell include:

- wooden_light_frame
- masonry_un
- rf_masonry (reinforced masonry)
- steel_light_frame
- un (stands for unknown)

- ot (stands for other)

Since we are looking at primarily historic masonry buildings, "masonry_un" will almost always be the entry type.

Note: Other possible input options will be listed in the **final_attribute_division_and_op** tab in the Excel sheet.

Uncertainty columns – unc (AK, AO, AQ, AT, AV, AX, AZ, CD, CG, CI, CO)

These columns can be completed after the entire dataset is completed (it's the easiest). All that needs done is matching the color of the column to the left, to its numerical certainty value 1, 2, or 3 (described in the first page of the document).

The reason for this is to convert the certainty color into a numerical value can be analyzed through code.

**mwfrs_u_wall (AL)

MWFRS – Main Wind Force Resisting System

Similar to construction type, but based on each part of the building (wall or roof). What is the main structural system for the WALLS of the building? What is the system made of which is resisting wind forces on the WALLS of the building? Input options:

- wall_diaphragm_masonry
- wall_diaphragm_wood
- wall_diaphragm_steel
- un

Note: Best approximation! If uncertain, you can highlight the cell with its related color.

**mwfrs_u_roof (AM)

What is the main structural system for the ROOF of the building? What is the system made of which is resisting wind forces on the ROOF of the building? Input options:

- roof_diaphragm_wood
- roof_diaphragm_steel
- un

**mwfrs_u_moment_frame (AN)

Best assumptions of whether the building has a moment frame or not; typically historic buildings so not have a moment frame. Input options:

- no
- yes

- un

**masonry_leaves (AP)

Masonry leaves are the number of layers of masonry in the walls of the building. Again, since you can't see the inner wall assembly, input your best guess based on the type of masonry construction (small family home vs. large brick building). Input options:

- double_leaf
- triple_leaf
- not_applicable (for buildings that aren't masonry)

As a rule of thumb, all unreinforced masonry buildings will have a double_leaf assembly (single leaf would be too unsupported if it is truly unreinforced).

structural_wall_system_u (AR)

Best approximation from imagery and any official documentation from historic listing (if present). Input option:

- masonry_block_unreinforced

There are other options, but this is what it will be if you are only looking at historic unreinforced masonry buildings.

**foundation_type_u (AS)

Knowing the foundation type of a building can be very hard to tell sometimes. The best thing to do is look at street view imagery or any official documentation from historic listings to see what the foundation is. Most likely it will be unknown or very vague. Most common options include:

- slab_on_grade
- stone
- masonry_un (looks like brick)
- unr_masonry_stem_wall
- un

This is definitely an approximate guess for most buildings, unless clearly stated somewhere.

Slab_on-grade	When zooming in, slab can be found	
Masonry_un	Has basement, definitely not slab-on-grade	

**wall_anchorage_type_u (AU)

Going to be unknown for almost all buildings, unless you're able to see those small features through the wall assemblies. So far, have been **putting "un" for all.**

**wall_substrate_u (AW)

Low certainty levels for most because only exterior cladding can be seen; assuming that there is no wall substrate when looking at historic unreinforced masonry buildings so **put "not_applicable" for all, unless given other information.**

Note: The masonry acts as the substrate in a way.

**wall_cladding_u (AY)

What material is used on the siding of the building? Common input options:

- brick
- cmu
- vinyl
- wood
- stone
- stucco

Note: If multiple types of cladding on a singular building, put what was used for the most coverage of the building.

soffit_type_u (BA)

Soffit – Cover the underside of the roof overhang and limit the ingress of wind-driven rain

Soffit can be hard to see but do your best to look through all imagery and Google Maps to determine what material it is. This can change over time due to renovations, so make sure you are looking at the latest date. Input options:

- wood
- vinyl
- stone
- un
- not_applicable

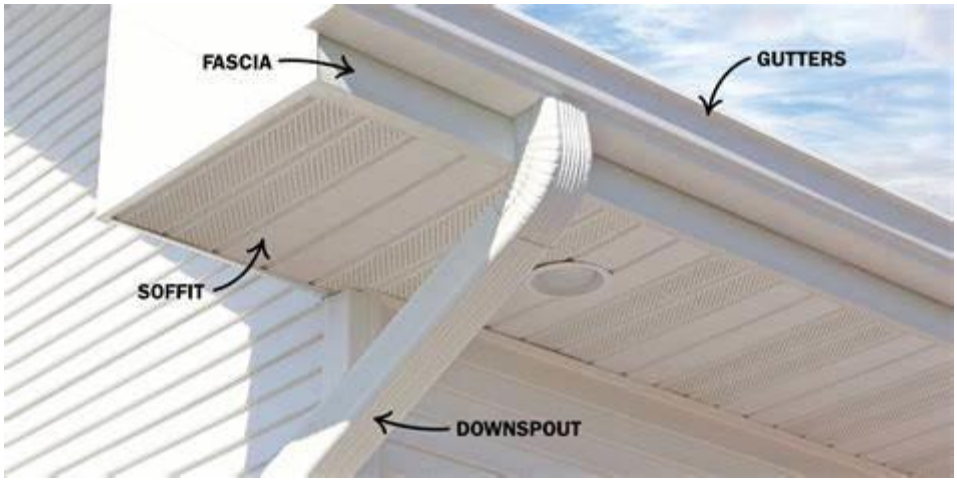


Figure 19

Note: Sometimes it is hard to tell whether an overhang counts as a soffit. Below are some examples of what is and is not soffit on a building.

SOFFIT	 This is considered a soffit due to how far it sticks out and provides covering from rain fall off.	
NOT A SOFFIT	 This covering does not protrude out far enough from the building to perform the function of a proper soffit.	

soffit_present_u (BB)

Is there a soffit present on the building or not? Some buildings are built to not have a soffit.

wall_fenestration_per_ (BC-BJ)

This is the percentage of openings in each side of the building; essentially what percent of the entire thing is made up of windows and doors?

Input will just be a number, from 0-100.

Note: Make sure to correctly correlate the side to its direction, based on what you decided in the beginning.

wall_fenestration_protection_ (BL-BP)

Is there fenestration protection present on the windows/openings? This can include storm shutters or plywood (before the tornado, not after!).

For most buildings in this area, it tends that the buildings do not have any fenestration protection. So **the input is "no".**

fenestration_protection_type_ (BQ-BT)

If the answer was yes to the previous question, you need to say what type of protection. For most, **the input will be not_applicable.** Other inputs, if present, include:

- plywood
- tornado_shutters
- unknown

(large_)door_present_ (BU-CB)

Are there any large doors present on the building? Large doors are only garage doors (you won't find many). For BY-CB, just "door" is still referring to garage doors.

Input options: yes, no, un

**roof_system_u (CC)

This is your best approximation of what structural system the roof is; very hard to say for certain from the outside. Input options:

- wooden_un
- wooden_rafters
- wooden_trusses
- open_web_st_joists
- steel_un
- un

r2wall_attachment (CE)

Will not be able to see or know this from outer imagery; **put "un" for all.**

**roof_substrate_type (CF)

Again, best approximation because you can't actually see the roof substrate. Try to go off of the time it was built and the roof system. Input options:

- dimensional_lumber
- un

**roof_cover_u (CH)

Determine this based on imagery, what material is the roof covering? Input options:

- asphalt
- corrugated_steel
- steel_un
- clay_shingles
- asbestos_shingles
- un

If you don't know what each of these looks like, you can Google it and look at the images for each and classify.

overhang_length_u (CJ)

This overhang length refers to the roof overhang length. Since we obviously can't measure this, it will be your best guess from visual inspection (measured in meters). Make sure that your input seems like a reasonable answer.

parapet_height_m (CK)

If the building has a parapet, use context and your own knowledge to create a guess at how high that parapet is (in meters). Keep in mind that the minimum height requirement for a parapet is around 0.75 m.

retrofit_year_u (CL)

Were there any major renovations, building additions, or structural retrofits to the building? If so, list them in this cell. If there are multiple retrofit years, list them using commas to separate.

retrofit_present_u (CM)

Simple "yes" or "no" is there is a retrofit present.

Note: To help see if there were any building additions, use the history tool on Google Earth Pro to scroll through all of the years available and see if any major additions were added.

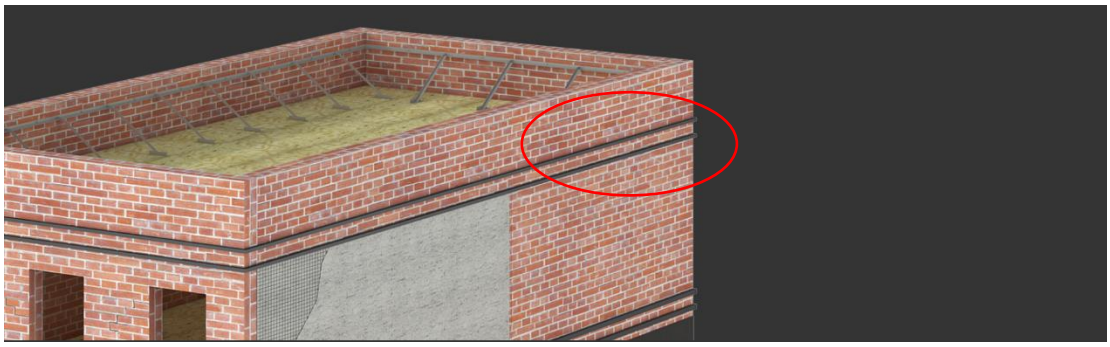
retrofit_type_u (CN)

Most common input options (more explanation at URM Building Seismic Retrofit Applications — Concrete Foundation | Simpson Strong-Tie):

- structural_restoration

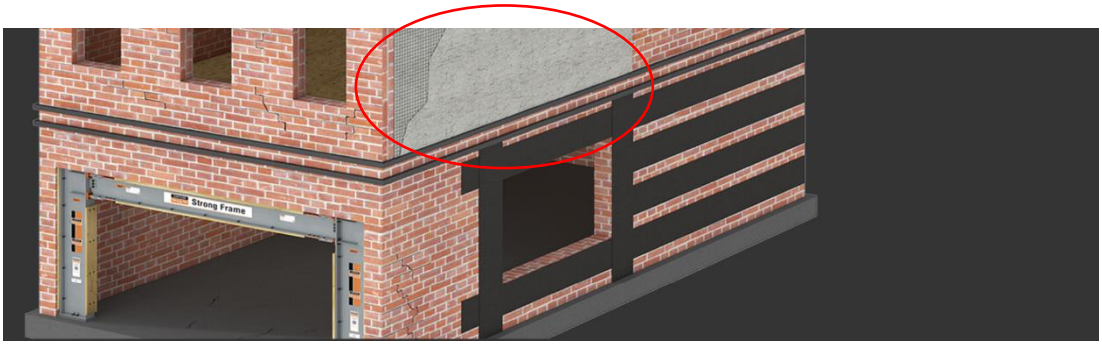
- building_addition
- parapet_bracing

- wall-to-roof_anchorage
- wall-to-floor_anchorage

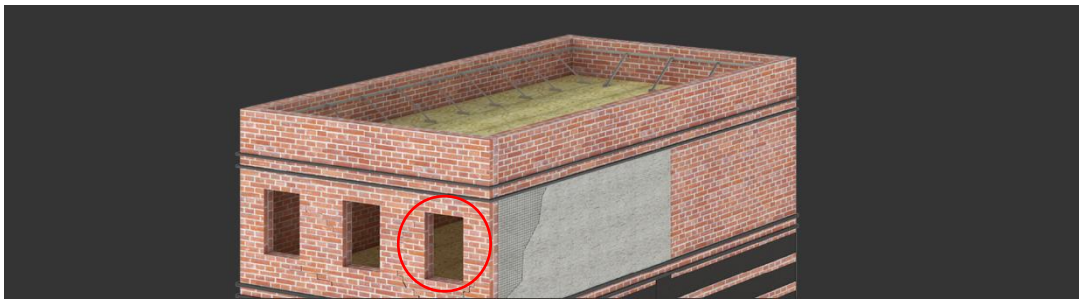


- out-of-plane_wall_bracing

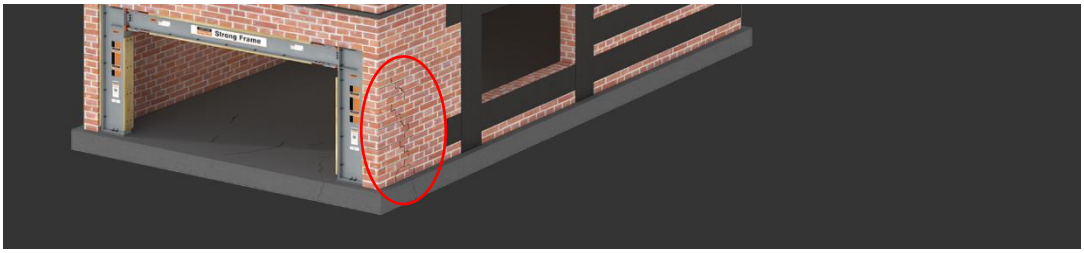
- lateral_shear_resistance



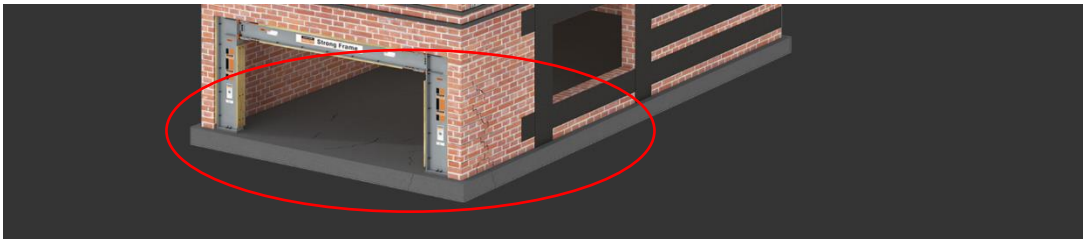
- diaphragm_strengthening



- veneer_anchoring_and_stitching



- concrete_foundation



- unknown

Opening Fulcrum to get Damage Information

RIGHT NOW, ONLY SHAYLA IS LOOKING AT FULCRUM (CAN SKIP)

1. Open Fulcrum online
2. Sign in with your provided username and password
3. You will then see various databases. Scroll down until you see “archive_StEER Building – US (windstorm)” and click “View Records” **(this is specifically for the Nashville Tornado)**

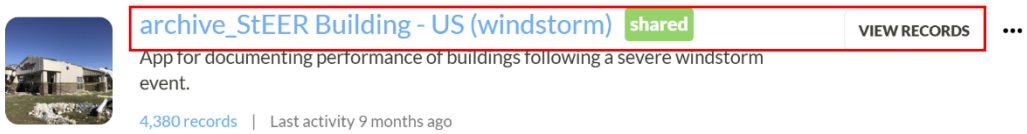


Figure 20

4. Search for the address using the search bar
5. Once the building is found, click on the colored circle to view the records for the building

hazards_present_u (CP) and status_u (CQ)

Note: If the building is not on Fulcrum (as a lot of buildings won’t be), assume wind for everything; tree_fall based on looking at surroundings from aeriel views and seeing if there is any tree fall.

1. Once in the data set for a particular building on Fulcrum, scroll down past the image section to the “Overall Damage Assessment”, shown in Figure 21.

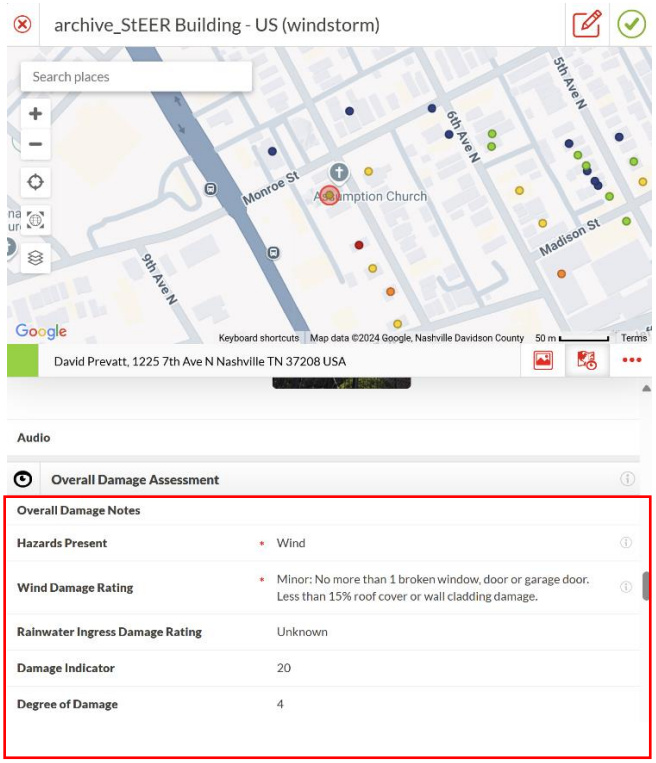


Figure 21

2. For the hazards_present_u cell, the data used will be the input for “Hazards Present”. Options include:
    a. wind
    b. wind-borne debris
    c. wind, wind-borne debris
    d. tree_fall
3. For the status_u cell, the data used will be the input for “Wind Damage Rating”. Options include:
    a. undamaged
    b. minor
    c. moderate
    d. severe
    e. destroyed

Note: If the building isn’t in Fulcrum, use your best guess for the damage status from what you can see on any available imagery.

Damage Columns (CR-EO)

These columns are used to describe the percent of damage to different parts and sides of the structure. In these columns, we’re looking at: roof structure, roof substrate, wall structure, wall cladding, fenestration, soffit, and fascia.

Note: If the building is not in Fulcrum, do your best to fill out this information based on what you can see.

1. Scroll down to the section “Wind-induced Damage Levels”
2. As you can see, there are sections for each of the column inputs, and you can use the values listed. The inputs will range from 0-100% because they are given as percentages. *If no value is listed in Fulcrum, just put 0.*

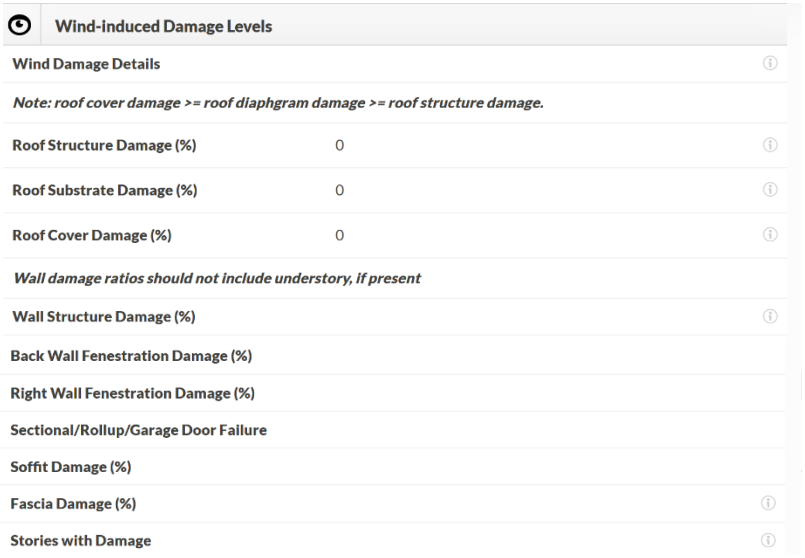


Figure 22

- **wind_damage_rating** – on a scale 0-5 how damaged the building is
- **damage_indicator_u** – same as wind damage rating
- **degree_of_damage** – same as wind damage rating
- **wind_damage_details_u** – in this cell you can write brief notes of the damage to the building (leave the space blank if there is no damage)

After this, then will come each component, with a **_u** and a **_u_per.** The **_u** columns will be on a scale of 0 to 5, while the **_u_per** columns are the same measurement but as a percentage of the overall building front 0 to 100 (what percentage of that specific component is damaged?).

Some may include directional (front, back, left, right AND n, s, e, w) so make sure to pay attention to that. If a building has not been damaged at all, the input for all of these columns will be 0.

- **piles_damage_u** – typically going to be **not_applicable**, unless there is damage to the piles of the building which can only be seen is 1. They are present to begin with and 2. The building is so destroyed that you are able to see them
- **foundation_damage_cause** – also have been putting **not_applicable** but if there is evidence of foundation damage, will need to be listed

risk_category_16 (EP)

Based on IBC Table 1604.5 Risk Category (Figure 23 below), mainly using 2 and 3. Input just the number of the category.

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing Group E occupancies with an occupant load greater than 250. • Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500. • Group I-2, Condition 1 occupancies with 50 or more care recipients. • Group I-2, Condition 2 occupancies not having emergency surgery or emergency treatment facilities. • Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000.a • Power-generating stations, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the International Fire Code; and Are sufficient to pose a threat to the public if released.[b]
IV	Buildings and other structures designated as essential facilities, including but not limited to: • Group I-2, Condition 2 occupancies having emergency surgery or emergency treatment facilities. • Ambulatory care facilities having emergency surgery or emergency treatment facilities. • Fire, rescue, ambulance and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communications and operations centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures. • Buildings and other structures containing quantities of highly toxic materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the International Fire Code; and Are sufficient to pose a threat to the public if released.[b] • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water storage facilities and pump structures required to maintain water pressure for fire suppression.

Figure 23

building_low_rise (EQ)

Typically anything 4 stories or less is low rise (less than 15 meters).

national_register_listing_year (ER)

Most of the buildings you will be looking at are probably not going to be nationally listed. But if the building is on the National Register listing page, there will be a listing year in which it was recognized/listed. Input this year.

existed_during_tornado (ES)

Did the building exist during the tornado? "yes" or "no"

building_use_BLANK_tornado (ET-EV)

Using the most current use (not the original historic building use), before and after the tornado. Here you will put the occupancy which was used in the occupancy column at the beginning, with the same options.

Building use plan after tornado is typically the same as the building use after the tornado.

demolishing_year (EW)

If it was demolished, in what year? If it was not demolished, just put **not_applicable**

single_unit OR multiple_unit (EX-EY)

From this point on, a yes will be input as a 1 and no will be 0.

Single unit – only one building use (e.g. single-family home, regular office buildings)
Multiple unit – multiple building uses/occupancies (e.g. condos, apartments, duplex, office buildings that have apartments on the second floor); singular building with multiple functions

Note: Can only be one or the other

National recognized listings (EZ-FD)

This is typically only shown for buildings which are on the national registry. When you look them up, it will say either "true" or "false" for each category. If not on the listing, it is up to your discretion, depending on the building, if it is a property of local significance (if so, then it gets a 1).

const_material_h_ (FE-FM)

Find this based on documentation and visual inspection. Is ___ material used for the foundation, floors, or roof?

KEY (for input): 1 for yes, 0 for no
h is horizontal materials (foundation, floors, roof)
rf means reinforced
rglr means regular
ir means irregular

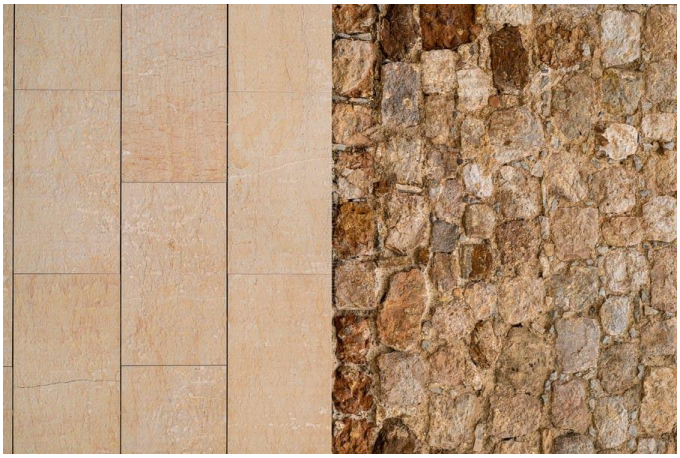


Figure 24: Example of regular vs irregular stone

const_material_v_ (FN-FV)

Find this based on documentation and visual inspection. Is ___ material used for the walls?

KEY (for input): 1 for yes, 0 for no
v is vertical materials (walls and other vertical members such as columns)
rf means reinforced
rglr means regular
ir means irregular

prop_"classification" (FW-HF)

This relates to the original occupancy type, **historically** what was its use? Again, use 1 and 0 to say yes and no respectively (should only be one 1 and the rest should be zeros for each building). The most commonly used classifications:

- prop_religious → churches
- prop_law / government facility → post offices, courthouses, fire stations, etc.
- prop_residential facility → single-family homes, apartment buildings, all lodging
- prop_commercial / exchange facility → all commercial/business buildings
- prop_educational facility → schools

prop_val_(HG-HJ)

Input options for each column: exceptional, considerable, some, limited, no value

- prop_val_evidential
    - Does the building hold a lot of historical values, belongings wise? Does it show pieces of history that can be used?
- prop_val_historical
    - How important is it in a historical context?
- prop_val_aesthetic
    - How aesthetic is it? Is it kept up?
- prop_val_communal
    - Is the building of local significance? How important is it communally?

owner_ (HK-HP)

At the time of the natural disaster, who was the owner of the building (may need to make some assumptions)? For this set, use 1 for yes and 0 for no. There should be only one 1 and the rest should be zero.

Note: take private colleges as businesses; public colleges are government; ngo stands for non-government organization

building_existed_#_years_before_tornado (HQ-HS)

Input for each should either be “yes” or “no”.

building_existed_during_tornado (HT)

Input for each should either be “yes” or “no”.

building_in_use_during_tornado (HU)

Input for each should either be “yes” or “no”.

building_use_during_tornado (HW)

Same as the occupancy type.

damage_status (HW)

Same as the damage status put prior in the set (severe, moderate, minor, undamaged).

building_demolished_#_yrs_after_tornado (HX-HZ)

Input for each should either be “yes” or “no”. Since the columns are in two-year increments, choose which one is closest to real date. For example, when looking at Google Earth Pro at a building, if you see it was demolished in 2022 and the tornado was in 2020, then you can say “yes” for demolished after 3 yrs (round up).

notes (IA)

This column is for any notes that need to be made, particularly any uncertainties. Some of the typical things include reasonings for choosing a certain archetype, mixed roof types, exactly when it was demolished, and other information you deem necessary.