Rapid Visual Screening of Buildings for Potential Seismic Hazards - Part 1: Preparation of Level 1 Data Collection

An Online Continuing Education Course for Engineers

Course Number: BD-5004

Credit: 5 Hours / 5 PDH / 5 CPD

Rapid Visual Screening of Buildings for Potential Seismic Hazards - Part 1: Preparation of Level 1 Data Collection Form

C. (Raj) Sundararajan, PhD., MASCE, FASME

Introduction

This course provides instructions on how to complete a Level 1 Data Collection Form (Figure 1). It is assumed that pre-field planning activities have already been conducted, including the selection of the Data Collection Form, based on the seismicity level of the area to be screened, and the determination of the soil type.

The Level 1 Data Collection Form is completed for each building screened through execution of the following steps:

1. Verifying and updating the building identification information;
2. Walking around the building to identify the number of stories and shape, and sketching a plan and elevation view on the Data Collection Form;
3. Photographing the building;
4. Determining and documenting occupancy;
5. Reviewing the soil type and geologic hazards, as identified during the pre-field planning process;
6. Identifying adjacency issues, building irregularities, and any potential exterior falling hazards;
7. Adding any comments about unusual conditions or circumstances that may affect the screening;

8. Identifying the building material, gravity load-carrying system, and seismic force-resisting system to identify the FEMA Building Type (entering the building, if possible, to facilitate this process) and circling the Basic Score on the Data Collection Form;

9. Circling the appropriate seismic performance attribute Score Modifiers (e.g., irregularities, design date, and soil type) on the Data Collection Form;

Rapid Visual Screening of Buildings for Potential Seismic Hazards — **Level 1**
FEMA P-154 Data Collection Form — **HIGH Seismicity**

PHOTOGRAPH

SKETCH

Address: _____
_____ Zip: _____
Other Identifiers: _____
Building Name: _____
Use: _____
Latitude: _____ Longitude: _____
S_S: _____ S_1: _____
Screener(s): _____ Date/Time: _____

No. Stories: Above Grade: ____ Below Grade: ____ Year Built: ____ ☐ EST
Total Floor Area (sq. ft.): _____ Code Year: _____
Additions: ☐ None ☐ Yes, Year(s) Built: _____

Occupancy: Assembly, Commercial, Emer. Services, ☐ Historic, ☐ Shelter; Industrial, Office, School, ☐ Government; Utility, Warehouse, Residential, # Units: ____

Soil Type: ☐A Hard Rock ☐B Avg Rock ☐C Dense Soil ☐D Stiff Soil ☐E Soft Soil ☐F Poor Soil ☐ DNK *If DNK, assume Type D.*

Geologic Hazards: Liquefaction: Yes/No/DNK Landslide: Yes/No/DNK Surf. Rupt.: Yes/No/DNK

Adjacency: ☐ Pounding ☐ Falling Hazards from Taller Adjacent Building

Irregularities: ☐ Vertical (type/severity) _____ ☐ Plan (type) _____

Exterior Falling Hazards: ☐ Unbraced Chimneys ☐ Heavy Cladding or Heavy Veneer ☐ Parapets ☐ Appendages ☐ Other: _____

COMMENTS:

☐ Additional sketches or comments on separate page

BASIC SCORE, MODIFIERS, AND FINAL LEVEL 1 SCORE, S_{L1}

FEMA BUILDING TYPE (Do Not Know)	W1	W1A	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	MH
Basic Score	**3.6**	**3.2**	**2.9**	**2.1**	**2.0**	**2.6**	**2.0**	**1.7**	**1.5**	**2.0**	**1.2**	**1.6**	**1.4**	**1.7**	**1.7**	**1.0**	**1.5**
Severe Vertical Irregularity, V_{L1}	-1.2	-1.2	-1.2	-1.0	-1.0	-1.1	-1.0	-0.8	-0.9	-1.0	-0.7	-1.0	-0.9	-0.9	-0.9	-0.7	NA
Moderate Vertical Irregularity, V_{L1}	-0.7	-0.7	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.5	-0.6	-0.4	-0.6	-0.5	-0.5	-0.5	-0.4	NA
Plan Irregularity, P_{L1}	-1.1	-1.0	-1.0	-0.8	-0.7	-0.9	-0.7	-0.6	-0.6	-0.8	-0.5	-0.7	-0.6	-0.7	-0.7	-0.4	NA
Pre-Code	-1.1	-1.0	-0.9	-0.6	-0.6	-0.8	-0.6	-0.2	-0.4	-0.7	-0.1	-0.5	-0.3	-0.5	-0.5	0.0	-0.1
Post-Benchmark	1.6	1.9	2.2	1.4	1.4	1.1	1.9	NA	1.9	2.1	NA	2.0	2.4	2.1	2.1	NA	1.2
Soil Type A or B	0.1	0.3	0.5	0.4	0.6	0.1	0.6	0.5	0.4	0.5	0.3	0.6	0.4	0.5	0.5	0.3	0.3
Soil Type E (1-3 stories)	0.2	0.2	0.1	-0.2	-0.4	0.2	-0.1	-0.4	0.0	0.0	-0.2	-0.3	-0.1	-0.1	-0.1	-0.2	-0.4
Soil Type E (> 3 stories)	-0.3	-0.6	-0.9	-0.6	-0.6	NA	-0.6	-0.4	-0.5	-0.7	-0.3	NA	-0.4	-0.5	-0.6	-0.2	NA
Minimum Score, S_{MIN}	*1.1*	*0.9*	*0.7*	*0.5*	*0.5*	*0.6*	*0.5*	*0.5*	*0.3*	*0.3*	*0.3*	*0.2*	*0.2*	*0.3*	*0.3*	*0.2*	*1.0*

FINAL LEVEL 1 SCORE, $S_{L1} \geq S_{MIN}$:

EXTENT OF REVIEW
Exterior: ☐ Partial ☐ All Sides ☐ Aerial
Interior: ☐ None ☐ Visible ☐ Entered
Drawings Reviewed: ☐ Yes ☐ No
Soil Type Source: _____
Geologic Hazards Source: _____
Contact Person: _____

LEVEL 2 SCREENING PERFORMED?
☐ Yes, Final Level 2 Score, S_{L2}: _____ ☐ No
Nonstructural hazards? ☐ Yes ☐ No

OTHER HAZARDS
Are There Hazards That Trigger A Detailed Structural Evaluation?
☐ Pounding potential (unless S_{L2} > cut-off, if known)
☐ Falling hazards from taller adjacent building
☐ Geologic hazards or Soil Type F
☐ Significant damage/deterioration to the structural system

ACTION REQUIRED
Detailed Structural Evaluation Required?
☐ Yes, unknown FEMA building type or other building
☐ Yes, score less than cut-off
☐ Yes, other hazards present
☐ No
Detailed Nonstructural Evaluation Recommended? *(check one)*
☐ Yes, nonstructural hazards identified that should be evaluated
☐ No, nonstructural hazards exist that may require mitigation, but a detailed evaluation is not necessary
☐ No, no nonstructural hazards identified ☐ DNK

Where information cannot be verified, screener shall note the following: EST = Estimated or unreliable data OR DNK = Do Not Know

Legend: MRF = Moment-resisting frame; BR = Braced frame; RC = Reinforced concrete; SW = Shear wall; URM INF = Unreinforced masonry infill; TU = Tilt up; MH = Manufactured Housing; LM = Light metal; FD = Flexible diaphragm; RD = Rigid diaphragm

Figure 1: Level 1 Data Collection Form (High seismicity)

10. Determining the Final Level 1 Score, SL1 (by adjusting the Basic Score from Step 8 with the Score Modifiers identified in Step 9); and

11. Completing the summary section at the bottom of the form (i.e., Extent of Review, Other Hazards and Action Required).

The form has been designed to be filled out from top to bottom, with a minimum of writing (most items can simply be checked or circled). The following sections provide instructions and guidance on completing sections of the form from top to bottom.

Building Identification Information

Space is provided in the upper right-hand portion of the Level 1 Data Collection Form (see Figure 2) to document building identification information (address, building name, use, latitude and longitude, and site- specific ground motion values), name of the screener(s), and the date and time of the screening. It is desirable to develop and document this information during the pre-field planning stage, if possible. This information may be filled out manually, or it can be preprinted on a peel-off label or printed directly onto the Data Collection Form.

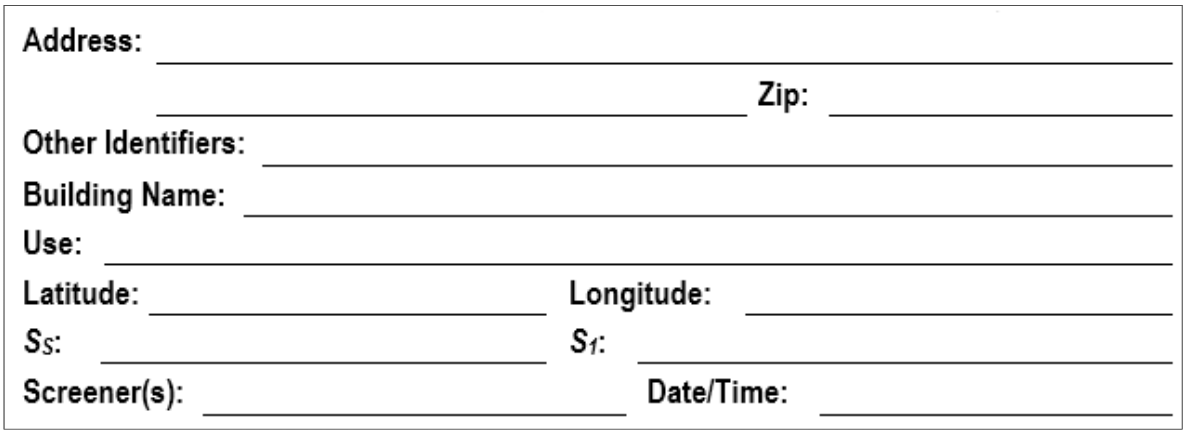

Figure 2: Building Identification Information portion of Level 1 Data Collection Form

Building Identification

Proper identification and location of the building is critically important for subsequent use in hazard assessment and mitigation by the RVS Authority. The structure can be identified by street address, parcel number, building owner, or some other scheme. However, it is recommended that as a minimum the street address and zip code be recorded on the form. Zip code is important because it is universal to all municipalities, and as such, is an especially useful item for later collation and summary analyses. Assessor parcel number or lot number is also useful for jurisdictional record-keeping purposes and can be entered in the "Other Identifiers" field on the form.

Caution should be exercised for buildings that contain multiple tenants with individual addresses for the same building structure. In these instances, it is suggested to include the full range of address numbers for the building, for example "6200 – 6250," and complete the screening for the building using one form.

Assuming the identification information is provided directly on the form, such information should be verified in the field. If the building identification information is not developed during the pre-field planning stage, it must be completed in the field.

Latitude and Longitude and Site Seismicity

Fields are provided to document the latitude and longitude of the building and to document S_S and S_1 values, which describe the site-specific ground motion. These fields may be completed during pre-field planning. Latitude and longitude can be determined using tools found on the internet. Once latitude and longitude are known, S_1 and S_S can be determined.

It is not expected that the screener will use these fields while performing the screening. However, they may be useful later for data keeping purposes or if electronic scoring will be performed. If a GPS device is available to the screener while at the building site, the screener should verify the latitude and longitude information on the form.

Screener Identification

The screener should be identified by name, initials, or some other type of code. At some later time, it may be important to know who the screener was for a particular building. The date and time of the screening should also be noted. In particular, noting the time of the screening will be helpful later in matching digital photos to the appropriate Data Collection Form.

Building Characteristics

Space is provided to document important building characteristics (see Figure 3). It is desirable to develop and document this information during the pre-field planning stage, if possible. This information may be filled out manually, or it can be preprinted on a peel-off label or printed directly onto the Data Collection Form. Assuming the information is compiled during pre-field planning, the information should be verified in the field. If the information is not compiled during the pre-field planning stage, it must be completed in the field.

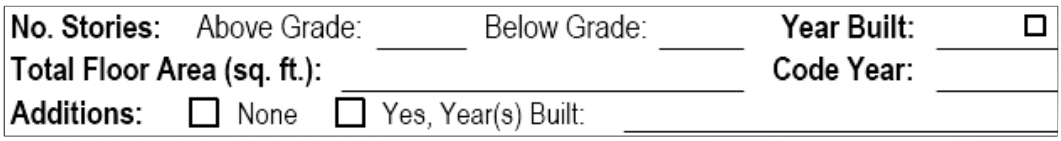

Figure 3: Building Characteristics portion of the Level 1 Data Collection Form

Number of Stories

The amount of damage a building may sustain is sometimes related to the height of a structure. The number of stories is a good indicator of the height of a building (approximately 9-to-10 feet per story for residential, 12 feet per story for commercial or office).

Counting the number of stories may not be a straightforward issue if the building is constructed on a hill or if it has several different roof levels. As a rule, the largest number (that is, count floors from the downhill side to the highest roof) should be used. The comment section and the sketch can be used to indicate variations in the number of stories.

The number of stories below grade should also be indicated if the screener can verify the number. Collecting this information is particularly useful if the community decides later to investigate flooding issues.