Quotation of the general comment: “They provide empirical fragilities for 4 building types. Also, they provide fragilities as functions of PGA using analytical methods. The authors say they “scrutinize 69 papers”. However the 18 of them are “thesis”. Is this acceptable?”

Response: Thank you for pointing this out. We’ll replace “papers” by “publications”. We didn’t mean to hide the fact that 18 publications we scrutinized are thesis. Actually, some theses provided very good collection of empirical fragility data from historic earthquakes, e.g. Piao (2013, thesis), Ding (2016, thesis).

Quotation of the general comment: “According to the reviewers knowledge the macroseismic intensity is influenced by many factors (e.g.: population, economy level etc.). So earthquakes of the same magnitude may cause different macroseismic intensity levels in various cities. Moreover the time period is too long. The damage stage depends not only on the type of the building but on the kind of the construction and the construction type has changed during these years.”

Response: Yes. We’re deeply aware of the change of building fortification performance over the past 40-year time span. Therefore, the available building construction fortification level and age information are intergrated into the classification of buildings into masonry_A, masonry_B, RC_A, RC_B types, with reference to the criteria listed in Table 3 of the manuscript.

And we totally agree that uncertainty is prevailing in every single step both in empirical and analytical fragility analysis, as pointed out in Page 2 line 1-13 in the manuscript. In this regard, besides carefully classifying the originally collected fragility data and conducting box-plot analysis, we also provided the standard deviation of the overall fragility distribution for each intensity and PGA level in Appendix Figure A1-A4 and Table B1. Further beyond that, we also spare quite a few efforts in charactering the uncertainty transmission from the fragility curve to the PGA-intensity relationship based on the data in the Appendix.

To avoid the manuscript to appear to be too sparse and extensive, we didn’t extend this uncertainty characterization process and only provide a reference uncertainty value of “0.3” in Page 9 line 9 for Eq. (5). However, for your further check, we put this methodology description in additionally uploaded file “Methodology of uncertainty transmission.pdf”.
(This file is available at https://app.box.com/s/lwlqajpogxqlau72ravew4db7y47drtk)

Quotation of the general comment: “A list of the ground motions used for this study is required.”

Response: We realized only the processed fragility data uploaded in the supplement is not enough. For your further check, here we also uploaded all the four original documents related to the preliminary processing of the collected fragility data: (available at https://app.box.com/s/lwlqajpogxqlau72ravew4db7y47drtk). Detailed explanation of each file and the building classification technique are given as follows:

(1) Filename "China Economic Loss and Vulnerability function review.xlsx":
This is our original records of fragility data extracted from the aforementioned scrutinized publications. Among those mentioned 87 publications, 71 have detailed fragilities given, the other 16 publications are either concept/method related or their data have been included in those 71 publications.
Sheet "site survey and statistic 36" includes empirical fragility data extracted from 36 publications without clear building fortification information, which will be estimated from available supplementary information;
Sheet "with fortification 16" includes empirical fragility data extracted from another 16 publications with clear building fortification information;
Sheet "analytical prediction 18" includes all the analytical fragility data extracted from 18 publications' tables or figures, among them some have clear building fortification information, others not;
Sheet "Ding Baorong 2016" is the fragility data collected by Ding (2016, doctoral thesis). Due to the high similarity in research purpose, we also digitalized these data and actually reiterated his/her work based the assumptions described in Ding (2016). This comparison will be explained later on.

(2) Filename "China Vulnerability records.xlsx":
Based on the results in Step (1), in this file the fragility data are further divided into different building groups: soil-wood, brick-wood, brick-concrete, analytical_masonry, RC, analytical_RC, industrial frame, stone-wood, Chuandou-timber, wood, stone and soil, as can be checked from each sheet with the same name. Here, 'brick-concrete' equals to masonry in our nomination. But for intensity-PGA relationship development, we have to focus only on masonry and RC, since analytical fragility data for other building types are not available.

(3) Filename "China Vulnerability analysis_plot.xlsx":
In this file, the exceeding probabilities of four damage limit states (LS1, LS2, LS3, LS4) are derived using Eq. (1) in the manuscript;
Given the main focus of this work as aforementioned and data abundance of each building type's fragility data, we finally focus on Sheets "brick-concrete", "analytical_masonry", "RC" and "analytical_RC" for further fragility curve derivation and PGA-intensity relationship exploration.

To fully use the fortification information given in each literature and make less assumption, we further add different fortification tags to empirical fragility data in Sheets "brick_concrete" and "RC", and to analytical fragility data in Sheets "analytical_masonry" and "analytical_RC";

The grouping criteria are as follows:
For empirical masonry fragility data in Sheet "brick-concrete": five tags specified in Column "Group of data" are used in differentiating the collected data: no fortification, unspecified fortification, low fortification, middle fortification and high fortification.
'no fortification' means there is no available information we can get from corresponding publication;

'unspecified fortification' means that in some publication, they mentioned the building is fortificated or unfortificated, but with no detailed fortification level information;
'low fortification' refers to buildings with VI level fortification as given in corresponding literature;
'middle fortification' refers to buildings with VII level fortification as given in corresponding literature;
'high fortification' refers to buildings with ≥VIII level fortification as given in corresponding literature.
Additionally, available building age information is used in grouping of fragility data extracted, like in Sheet "brick-concrete" from Hu & Sun (2010).

For analytical masonry fragility data in Sheet "analytical_masonry", in Column "Group of data":
'low-middle fortification' refers to buildings modelled with 0.05g~0.2g fortification as described in corresponding literature;
'high fortification' refers to buildings modelled with ≥0.3g fortification as described in corresponding literature.

For empirical RC fragility data in Sheet "steel-RC", the grouping criteria are similar to that in "brick-concrete", with slight difference in that given RC buildings are generally have better fortification performance than masonry, so in publications where building fortification information is not available, we mark it as "unspecified fortification" , as can be checked in Column "Group of data" as well.

For analytical RC fragility data in Sheet "analytical_steel", the grouping criteria are similar to that in "analytical_masonry", with slight difference that since RC buildings are generally have better fortification performance than masonry, so in publications where building fortification information is not available, we also mark it as "unspecified fortification".

Besides that, in Sheet "analytical_masonry", fragility data based both on PGA and SA are collected, but since for masonry building, only PGA related fragility data are available, so finally we only use PGA related analytical fragility data for RC buildings.

(4) Filename "China Vulnerability analysis_plot_result.xlsx":
This file is not so much different from the file in Step (3), only that we regroup the data with different fortification level assigned in Step (3) and plot the fragility distribution.

To achieve certain statistical significance of the fragility data analysis, in this step subjective judgement is necessary. Thus for brick-concrete or masonry buildings, we assign "masonry_A", "RC_A" building type to represent those with

unspericifed/low/middle fortification level tag in Step (3), and “masonry_B”, “RC_B” to include those with high fortification level tag in Step (3), as also described in Page 5: line 18-23 in the manuscript.

The data uploaded in the online supplementary material (or the invalid personal link) is the classified fragility data extracted from this file.

Quotation of the general comment: “The link on page 5, line 27 does not work.”

Response: The first author is quite sorry for the inconvenience caused due to the addition of the invalid personal link in Page 5: Line 27. It was meant to provide more access to the fragility data uploaded in the online supplementary material. We’ll remove this link and directly recommend readers to download the online supplementary material, which is the same content as this invalid link refers to.

Quotation of the general comment: “Many references are not adequately written (e.g.: the journal is missing, or the pages are missing etc.)”

Response: Thank you very much for your careful check. The first author has no excuse for this kind of carelessness. After rechecking the 103 references, at least 10 of them are obviously incomplete. We’ll definitely rectify that one by one.

References:

Ding, B.: Study on Related Quantitative Parameters of Seismic Intensity Scale, Thesis, Institute of Engineering Mechanics, China Earthquake Administration, Harbin, China, 195, 2016.
Piao, Y.: Study on Housing Seismic Vulnerability of Yunnan and Qinghai Province, Thesis, Institute of Engineering Mechanics, China Earthquake Administration, Harbin, China, 72, 2013.