

Response to Referee#1

Note: Comment of Referee 1 is in Green and Referee 2 is in blue colour

We would like to thank both the reviewers for taking the time to assess our manuscript and giving positive and insightful comments on it that has enhanced our manuscript.

We have addressed all the concerns they raised. Our responses to each of their comments are as follows:

Line 23-29: A comprehensive review of various existing survey forms for Risk assessment has found that the survey questionnaires themselves have not been designed or optimised, specifically, for hill communities. Hill communities are distinctly different from low-land communities, with distinct characteristics and susceptibility to specific hazard and risk scenarios. Previous studies have, on the whole, underrepresented the specific characteristics of hill communities, and the increasing threat of natural disasters in the IHR creates an imperative to design hill-specific questionnaires for multi-hazards risk assessment.

Comment (R1)-1: In line 23-29, If it has some international application in some other countries, give some names or suggest in brief what modifications can be made to convert them for international use specifically in some Asian countries.

Response: We appreciate the reviewer, for bringing out attention to this point. We agree with you about its scope in other Asian countries with Himalayas, however our paper has applied only in Indian Himalayan region till now and focus on the same. Taking your suggestion into consideration, addition have been made in the conclusion section.

Line 35: The survey form covers data related to vulnerability from Earthquake (Rapid Visual Screening), Flood, Landslide, High Wind, Industrial etc.

Comment (R1)-2: In line 35, It's researcher's work, so it should be clear what hazards have been considered. Do not use term etc. Name hazards which you are considering in particular.

Response: We appreciate the reviewer for pointing this out. Taking this comment into consideration, we have revised this line.

Line 87-88: The Indian Himalayan Region (IHR) straddles the northern latitudes of 26 20' and 35 40', and the eastern latitudes of 74 50' and 95 40'.

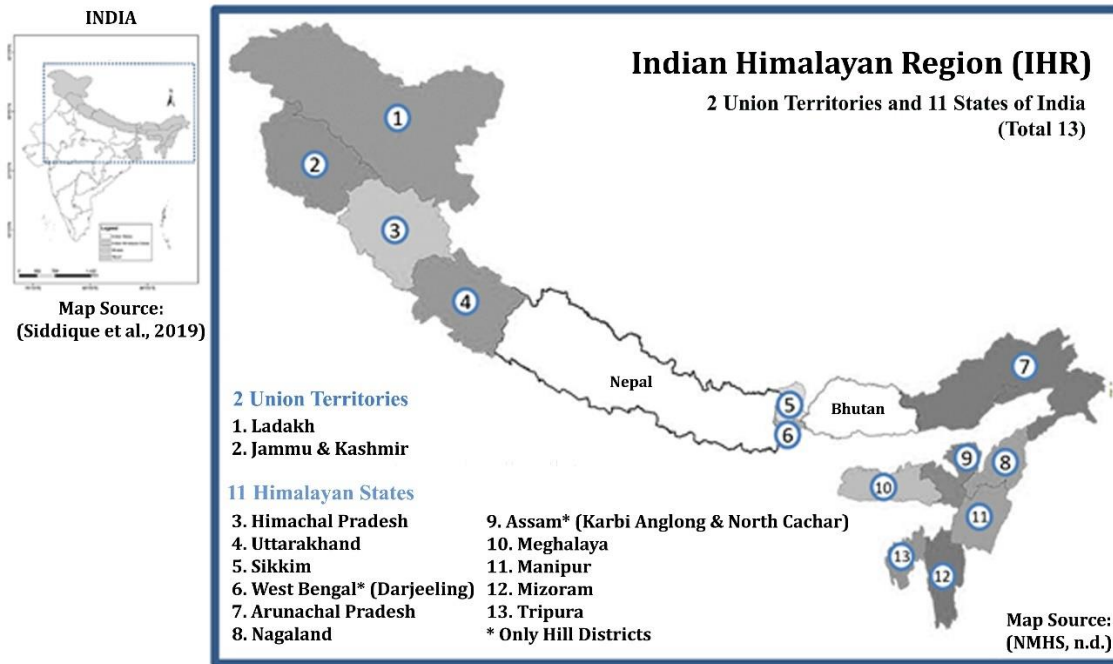
Comment (R1)-3: In line 87-88, give reference of this data

Response: Taking this comment into consideration, we have added Reference to this line.

Line 92: There are a total of 12 Indian Himalayan states and 1 Union territory as shown in Figure 1, which has 109 administrative districts (Kala, 2014).

Comment (R1)-4: In line 92, There are two Union Territories not one accordingly modification are needed in text.

Response: We appreciate the reviewer's insightful observation and taking this comment into consideration, we have updated it in text as well as in figure 1.



Line 96: Tourism is a lucrative business in IHR (Gaur and Kotru, 2018) and it contributes to support a lot of construction projects like dams across the region (Kala, 2014).

Comment (R1)-5: In line 96, How tourism helps in construction of Dam Project. I think something is missing. Please modify.

Response: We appreciate the reviewer's insightful observation. Taking this point into consideration, modification has been done in this line.

Line 128: Table 1: Major Disaster Events in IHR, Column 3 is Location. Source: adapted from (BMTPC, 2019), (Kumar et al., 2016).

Comment (R1)-6: In line 128, In table 1 in column 3 Location- what these numbers in column represent clarify.

Response: Taking this comment into consideration, we have added the description in bracket (at third column of table 1) as Latitude and Longitude.

Comment (R1)-7: Table 2 is summary of Table3. This may be stated here. In fact, here author may give other such studies if carried out by some states. This part is need assessment only so why Table 2 is required which is summary of your main work.

Response: We appreciate the reviewer's insightful recommendation. I agree with you that Table 2 is the summary, however it is to show the need of this study in a summarized way. On the other hand, Table 3 is the detailed comparison of all the existing survey form used in India and the proposed survey form. Because of this reason, we would like to keep it as it is.

Comment (R1)-8: Section 3. Onwards:

Comment (R1)-8.1: (i) Methodology of designing forms is suggested by Author or adopted from somewhere not clear. If adopted reference is required

Response: Taking this point into consideration and for better clarity, we have updated the caption of figure 2 as “Methodology adopted by author”

Comment (R1)-8.2: (ii) As per figure 2, after MHRA Form application, on 20 schools what modifications have been done in form if any? It may be included.

Response: We appreciate the reviewer’s insightful suggestion. I would like to highlight that application on 10 schools (please note its 10 schools) was done with the final proposed survey form. Before application in these schools, the gaps identified in the existing survey forms and observation during preliminary survey are described in section 3.4.1 and 4.2.1 respectively.

Comment (R1)-8.3: (iii) No need to discuss four levels assessment when it is not done and used.

Response: We appreciate the reviewer’s insightful suggestion. We agree with the reviews, removing this section will not impact the literature of the manuscript. Thus we removed this part as per your suggestion.

Comment (R1)-8.4: (iv) One relevant code to assess seismic vulnerability IS15988 is missing

Response: Taking this point into consideration, we have added IS-15988 (2013) in section 4.4.

Comment (R1)-8.5: (v) Please change the IS 1893-2002 to IS 1893-2016

Response: We appreciate the reviewer’s insightful suggestion. I would like to highlight that IS-1893-2016 is already mentioned in section 4.4. However, taking this point into consideration, we have removed IS-1893-2002.

Comment (R1)-8.6: (vi) Figure 3: It is BIS Map as per IS 1893 not GSI. Figure quality needs improvement.

Response: We appreciate the reviewer’s insightful suggestion. Taking this point into consideration, we have added all the sources including BIS. All the high quality images has already been send separately.

Comment (R1)-9: Line365 onwards:

Comment (R1)-9.1: BMTPC is based on typology /material as per Census of India only this may be included.

Response: Taking this point into consideration, we have updated it in section 3.3.3.7.

Comment (R1)-9.2: Quality of Table 3 requires improvement.

Response: We thank the reviewer’s for highlighting this point. This is to inform you that a file with high pixel quality is already send as a separate file.

Comment (R1)-9.3: Quality of Figure 4 needs improvement It is part of Table 3 only.

Response: We thank the reviewer's for highlighting this point. This is to inform you that a file with high pixel quality is already send as a separate file.

Comment (R1)-10: In Section 3.3.5, Include some details of Industrial hazard also.

Response: We thank the reviewers for this suggestion. As existing multi-hazard survey forms used in India does not focus on Industrial hazard (table 2), we have not mentioned it in section 3.3.3 and 3.3.4. However, as a value addition of the proposed survey form, we have already mentioned it in table 4 and section 5.2.

Comment (R1)-11: In Section 4.

Line 448 onwards: Whilst the Himalayan region is prone to earthquakes as per India's Seismic Zonation Map (Figure 3) prepared by the Geographical Survey of India (GSI), the proposed survey form also covers other hazards like landslide, flood, industrial explosion/emissions, fire, hydro-climatic factors, etc., which will be addressed one by one in this paper.

Comment (R1)-11.1: (i) Line 448: BIS Map not GSI

Response: We appreciate the reviewer's insightful recommendation. Taking this point into consideration we have modified it.

Comment (R1)-11.2: (ii) Write details as per steps of your methodology given in figure 2, in sequence.

Response: We appreciate the reviewer's insightful suggestion. I would like to highlight that the methodology is already explained in section 3.2. and detail of every step is explained in section 4.

Comment (R1)-12: In Section 4.2.1

Should establish your hard work of going to field in view of your methodology

Response: We thank you for appreciating our hard work.

Comment (R1)-13: Some General Observations:

Comment (R1)-13.1: If wind hazard is done as per IS code give reference. Similarly for hazards other than seismic give references which you must have referred in case not included.

Response: Considering this point we have added all the references in section 4.4

Comment (R1)-13.2: You are considering building related fire vulnerabilities and not forest fire. It may be clarified.

Response: We appreciate the reviewer's insightful opinion from readers point of views. Taking this point into consideration, we have identified all related words and modified it.

Comment (R1)-13.3: Climate change has been addressed in form. It has to be included in text also.

Response: We appreciate the reviewer's suggestion. Taking this point into consideration, we have made the addition in section 5.2.

Comment (R1)-13.4: It seems you have plan to assess seismic vulnerability of structure and superimpose all vulnerabilities together on regional plan in future if so, describe it in end as future research in progress.

Response: We appreciate the reviewer's futuristic suggestions. In order to strengthen it further, we have made the modifications in the conclusion section.

Comment (R1)-13.5: It will be good to represent designed form in pictorial manner or in brief. Detailed Form can be attached as Annexure appropriately if authors agree.

Response: We appreciate the reviewer's helpful proposal from surveyor's point of views. We can provide a separate annexure as "Survey form", if required.

Response to Referee#2

We would like to thank the reviewers for taking the time to assess our manuscript and giving positive and insightful comments on it that has enhanced our manuscript.

We have addressed all the concerns they raised. Our responses to each of their comments are as follows:

Comment (R2)-1: The manuscript contents useful information regarding the multi-hazard risk assessment survey in the Indian context. However, due to rather scanty write-up of the manuscript, the idea, work conducted, and outcomes of the presented research are not conveyed well.

Response: We would like to thank the reviewer for their comments. We have considered all your insightful suggestion and provided our comments as follow.

Comment (R2)-2: The National Building Code of India (2016) published by the Bureau of Indian Standards (BIS), New Delhi, describes the 'Multi-Hazard Risk Concept' and 'Multi-Hazard Prone Area,' which can be helpful for the readers if included in the review presented by the authors in the manuscript.

Response: Thank you so much reviewer for sharing this information. We agree and have updated it in the introduction section.

Comment (R2)-3: (1) The need and relevance of variety of multi-hazard scenarios and risk assessment thereof for infrastructure in case of India should be highlighted in the introduction. (2) This aspect in the context of, multi-hazard analysis and design guidelines: recommendations for structure and infrastructure systems in the Indian context, which has been discussed earlier-on provides basis for further investigation, as being dealt with in the present study. (3) Moreover, the existing strategies of risk assessment of the infrastructures in areas of India subjected to multi-hazard should be mentioned to provide a broad perspective in this research area.

Response: We appreciate the reviewer's suggestion. (1) We agree with the reviewer however the brief about the variety of multi-hazard scenarios and risk assessment used in India is already explained in section 3.3.3 and need of it is explained in section 2.3 of the manuscript. (2) Study of design guidelines and recommendations from Indian context is in itself a huge study. We have planned it to be the part of separate article, as this manuscript focus only on design and application of the proposed survey form. (3) The brief about existing strategies of risk assessment used in India has been already explain n in section 3.3.3.

Comment (R2)-4: Also, the authors mainly talked about multi-hazard risk assessment in the Indian context; however, the study of how the assessment is being otherwise done globally, and associated future challenges can certainly improve the questionnaire, i.e., learning lessons from other parts. Hence, multi-hazard analysis and design of structures: status and research trends, which should provide that kind of global perspective to the readership should be included in the present manuscript.

Response: We agree with the reviewer that further elaborating lesson learnings from other part of the world could provide global perspective to the readers. However, we believe that the Multi-Hazard Risk Assessment executed globally is in itself a huge study (brief of some of it is describe in section 3.3.4 of the manuscript) and our manuscript focuses only on the Indian Himalayan Region; thus, we would like proceed as it is.

Comment (R2)-5: The manuscript has mainly focused on the natural hazards in the manuscript. However, multi-hazards can include manmade (/accidental) hazards, such as blast, explosion, fire outbreak, etc. which can cause extensive risk to communities and infrastructures, even in the area of question in the present manuscript. Therefore, a section needs to be added to the questionnaire regarding such manmade hazards.

Response: We appreciate the reviewer's insightful suggestion. We would like to highlight here that the proposed survey form consists of questions related to man-made hazards like Industrial hazard (Part B, question no. 17 to 20), Fire vulnerability (Part B, question no. 21 to 35) and non-structural risk (Part B, question no. 40 to 42). However other man-made hazards are beyond the scope of this research.

Comment (R2)-6: The "mixed use", terminology in the survey form can be replaced with "combined use" for better understanding. There are many sections in the survey form, where the asked information may not be clear, especially for low-skilled engineers or surveyors; therefore, this reviewer recommends providing symbolic figures for better understanding. For instance, Sections 57 and 64 (grade of cracks) can be presented with an illustrative figure. Furthermore, another column can be added in many sections in case of not finding any existing option true; for instance, in Sections 58 and 65, other failures and cracks can be added.

Response: We appreciate the reviewer's insightful observations and suggestion. Taking this point into consideration, we have added symbolic figure in the options of Question 58 – type of wall failures. However, on the other hand, as per URDPFI Guidelines, the terminology used for such Landuse of the building is "Mixed use", thus we would like to remain with the same terminology and this is to highlight that the pictorial explanation of cracks is already given in question 63 and 64 of the proposed survey form (Part-A), however, question 57 does not required pictorial explanation.

Comment (R2)-7: (1) In the section "Pounding Effects Details "in the survey form, instead of the subsection "Quality of adjacent building" can be replaced with material and number of floors of adjacent building for checking the capacity of the adjacent building. Subsection 79 can appear after the point mentioned in Subsection 80. (2) The definition of short and long columns provided in the survey form needs to be improved for clear understanding. (3) In Table 6a, providing the options of the range of wind speeds can be more helpful than the option of average wind speed. (4) The authors have conducted a pilot survey; however, all necessary details of the site conditions and pictures need to be included.

Response: We appreciate the reviewer's insightful observations and suggestion. Taking this comment into consideration, (1) in section "Pounding Effect details", we have switched the question 79 with question 80 in the proposed survey form. However, quality of adjacent building has already been asked in question 81 with 5 ranges of quality from very good to very bad. However separate analysis of individual adjacent building will be more beneficial. (2) The explanation of short and long column has already been explained in the pictorial manner wherever required, example question 98, 107, 111 of the proposed survey form. (3) Range of wind speed is modified in the proposed survey form. (4) As this manuscript focus on the designing and application of the survey form, the detail of pilot survey is in itself a huge part and can be a separate article. However, taking this point into consideration, we have added the pictures of 10 school buildings in section 4.5.2. In past 1 years, the proposed survey form is applied over 500+ buildings and we are working for the next article on it.

Comment (R2)-8: In addition, there are several editorial mistakes throughout the manuscript, which can and must be corrected. Some of them are mentioned in Points 7 and 8 merely for indicative reference purposes. There is a repetition of the same content and sentences, which can be avoided for better readability. The complete form of abbreviation used, such as MS/SS, should be mentioned.

Response: We appreciate the reviewer's insightful suggestion. In order to strengthen it further, we have done all the modifications including providing the complete full form of the abbreviations in the proposed form after every section where applicable.

Comment (R2)-9: (1) The whole manuscript has inconsistencies in formatting, font size, and unnecessary capitalization of the first letter of the words. While citing the tables and figures in the text, the first letter should be capitalized; for example, in line 170, it can be "Table 2". (2) Also, the quality of the figures and sub-figures require enhancement. (3) The references should be arranged with a consistent formatting style.

Response: We appreciate the reviewer's helpful suggestion. Taking this comment into consideration, (1) We have identified the text (table and figure) and capitalized the first letter as Table and Figure (2) The images with better high quality pixel size is already send as a separate file (3) Referencing style is improved as per journal's guidelines.

With the suggestions provided, quality of the manuscript can be improved significantly, and the manuscript can be beneficial for engineers and surveyors in assessing the multi-hazard risk for communities and infrastructures.

Response: Thank you so much for your appreciation and comments.