# A Study on Seismic Source Maps and b-values for Reducing Uncertainty of Seismic Hazard

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## 1. Introduction

A probabilistic seismic hazard analysis (PSHA) was performed for Shinuljin 1&2 site [1]. Researchers performed sensitivity analysis about seismic source, Gutenberg-Richter parameter, attenuation equation, maximum magnitude and focal depth. The result showed that the source which included a site has a great effect on total seismic hazard by the result of sensitivity analysis. The Gutenberg-Richter parameter was identified as the most uncertain factor in the sensitivity analysis [2, 3]. For this reason, this study was performed in order to reduce uncertainty of seismic hazard by improvement of seismic source and Gutenberg-Richter parameter.

## 2. Selection of Seismic Source Map

For the selection of seismic source maps for the improvement of PSHA for Shinuljin 1&2 site, expert panels evaluated previous studies about seismic source maps. The seismic hazard was calculated from 8 seismic source maps by 4 teams for PSHA of Shinuljin 1&2 site [1]. But in this study, expert panels suggested 4 seismic source maps from 11 seismic source maps which suggested best estimation of 11 teams (Shinwolson 1&2, Shinkori 1&2, Shinuljin 1&2). Table 1 summarized the suggested 11 seismic source maps and their assessment results. Result of seismic source maps that were selected in this study are indicated by grade in Table 1. Finally, seismic source maps that were selected in this study are shown in Fig. 1.

Table 1: Result of Expert Panel Survey on Source Map

| Source map | grade | weight | rank |
|---|---|---|---|
| Shinwolsong 1&2 A | 78 | 0.131 | 1 |
| Shinwolsong 1&2 B | 56 | 0.094 | 8 |
| Shinwolsong 1&2 C | 59 | 0.099 | 5 |
| Shinkori 1&2 1 | 70 | 0.118 | 3 |
| Shinkori 1&2 2 | 74 | 0.125 | 2 |
| Shinkori 1&2 3 | 30 | 0.051 | 9 |
| Shinkori 1&2 4 | 68 | 0.114 | 4 |
| Shinuljin 1&2 A | 13 | 0.022 | 11 |
| Shinuljin 1&2 B | 59 | 0.099 | 5 |
| Shinuljin 1&2 C | 58 | 0.098 | 7 |
| Shinuljin 1&2 D | 29 | 0.048 | 10 |

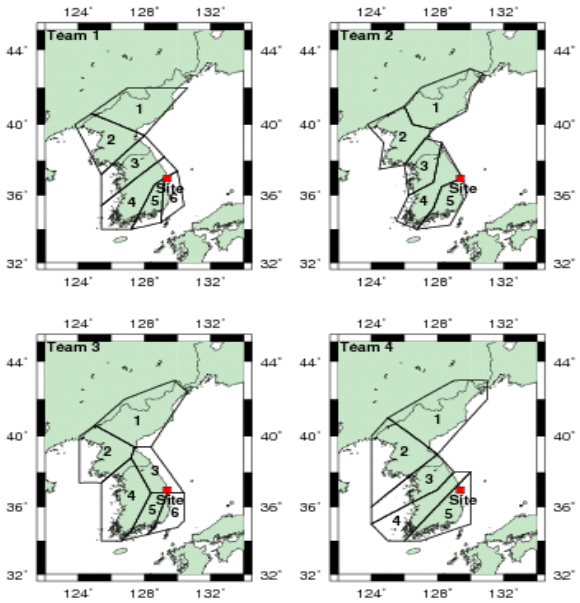


Fig. 1. Selected Seismic Source Map which Proposed by Expert panels in This Study.

## 3. Correction of b-value

Expert panels estimated input parameter for the correction of the Gutenberg-Richter parameter. Expert panels suggested that determination of maximum and minimum limit were necessary in Gutenberg-Richter parameter. Because the Gutenberg-Richter a-values were suggested by different ways, it is impossible to perform a direct comparison each other. Therefore, this study performed a study on the Gutenberg-Richter b-value. As a result, the Gutenberg-Richter b-value was determined whereby the average correction is 0.96 and the maximum and the minimum correction are 1.06 and 0.74, relatively. These levels were determined from suggested weight factors by expert panels.

## 4. Result

### *4.1 Source effect*

The mean seismic hazards for each seismic source map at 1.0g of Shinuljin 1&2 site are shown in Table 2. The original seismic hazard curves for Shinuljin 1&2 site and the modified seismic hazard curves in this study are shown in Fig.2. The modified seismic hazards were calculated from the suggested seismic source map by expert panels in this study. As shown in Table 2 and

Fig.2, the mean seismic hazard decreased about 40% at 1.0g level. Also, it can be recognized that the uncertainty range was decreased in the case the results presented here.

Table 2: Mean Seismic Hazard to each Seismic Source Map at 1.0g for Shinuljin 1&2

| Origianal (at 1.0g) | | Selected Source map (at 1.0g) | |
|---|---|---|---|
| Mean | 1.173E-06 | Mean | 6.988E-07 |

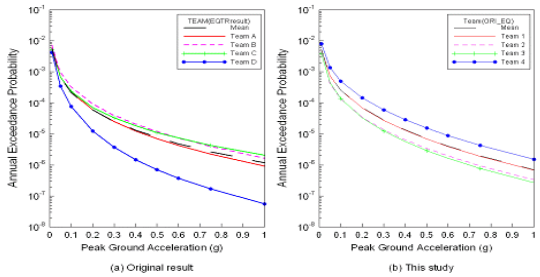


Fig. 2. Seismic Hazard Curves for each Seismic Source Map of Shinuljin 1&2

*4.2 Influence of b-value*

The seismic hazard was calculated, after correction of the Gutenberg-Richter b-value of about average and minimum level. The seismic hazard was calculated from a b-value of 0.96 for the average correction. When the original b-value was smaller than b-value level of 0.74, the seismic hazard was calculated from a b-value of 0.74 for the minimum correction. Table 3 summarized seismic hazard due to b-value correction. After the correction of average level, the seismic hazard was smaller than original seismic hazard about 60%. Also after the correction of minimum level, the seismic hazard was smaller than original seismic hazard about 30%.

Table 3: Seismic Hazard due to b-value Correction

| PGA | Original | Avg. value correction | Min. value correction |
|---|---|---|---|
| 0.01 | 5.327E-03 | 3.933E-03 | 4.857E-03 |
| 0.05 | 7.506E-04 | 4.892E-04 | 6.390E-04 |
| 0.10 | 2.592E-04 | 1.527E-04 | 2.110E-04 |
| 0.20 | 7.048E-05 | 3.670E-05 | 5.458E-05 |
| 0.30 | 2.832E-05 | 1.374E-05 | 2.136E-05 |
| 0.40 | 1.354E-05 | 6.289E-06 | 1.005E-05 |
| 0.50 | 7.190E-06 | 3.240E-06 | 5.279E-06 |
| 0.60 | 4.111E-06 | 1.813E-06 | 2.996E-06 |
| 0.75 | 1.969E-06 | 8.473E-07 | 1.423E-06 |
| 1.00 | 6.988E-07 | 2.929E-07 | 5.009E-07 |

Fig. 3 shows the results of seismic hazard curves according to the Gutenberg-Richter b-value. The hazard curves of the original result are shown Fig.3 (a). The hazard curves to average value correction and minimum value correction are shown Fig.3 (b) and Fig.3 (c), relatively. There seems a wide difference between the fractaile hazard curve of 15% and that of 85% to peak ground acceleration. The difference between fractaile hazard curve of 15% and 85% was about 6.3 times the original result that was calculated from uncorrected b-value. But the difference of average correction was about 2.9 times and the difference of minimum correction was about 4.1 times.

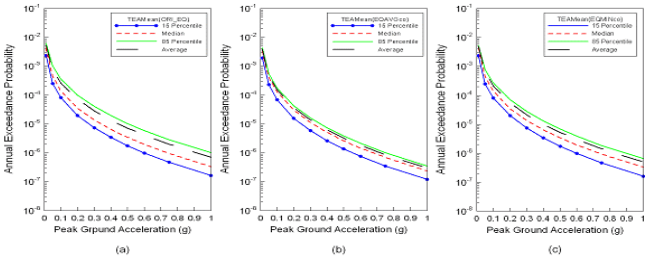


Fig. 3. Comparison of Seismic Hazard Curves for Shinuljin 1&2, (a) Original result, (b) The average correction of b-value, (c) The minimum correction of b-value.

## 5. Conclusion

For the purpose of decreasing seismic hazard uncertainty, seismic source map and Gutenber-Richter b-value were considered. Through expert panel discussion, seismic source maps were determined and decided. The uncertainties of seismic hazard curves according to the seismic source were compared. The Gutenberg-Richter b-value was also determined through the same expert panel discussion. Using the proposed average and minimum correction of Gutenberg-Richter b-value, seismic hazard curves evaluated and compared each other about seismic hazard uncertainty. Finally, it can be concluded that the uncertainty of seismic hazard can decrease using the re-evaluation of seismic source model and modification of Gutenberg-Richter b-value. Also, the result of the average correction of b-value shows that the seismic hazard level decreased.

## ACKNOWLEDGEMENT

This work was supported by Nuclear Research & Development Program of the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korean government (MEST). (grant code: M20702030003-08M0203-00310)

## REFERENCES

[1] H. M. Rhee, J. M. Seo, and I. K. Choi, A study on the uncertainty of seismic hazard in the PSHA for a Korean NPP site, 10th KJPSA workshop, pp. 653-662, 2009.
[2] J. M. Seo, H. M. Rhee, I. K. Choi, and H. J. Yoo, A study on the sensitivity of the Gutenberg-Richter parameter value on the seismic hazard in Korea, EESK spring conference, pp. 31-38, 2009.
[3] J. M. Seo, I. K. Choi, and H. M. Rhee, A study on seismic parameter and a logic tree in the PSHA for a NPP safety, Transaction of the KNS spring meeting, pp.1079-1080, 2009.