Revised Manuscript based on Referee Comments – Referee #1

I deeply appreciate for the review of the paper. I am glad to change the errors of the manuscript based on referee comments. The change in new text file with red mark is following as,

01: Page 392 line 26, add expansion of RR

Page 4 line 95: the algorithm of RR → the algorithm of **repair rate (RR)**

02: Page 393 line 1,

Page 4 line 73: peak ground velocity (PPV) → peak ground velocity (**PGV**)

03: Page 402 - Table 2

Page 14 line 309: 1,000 mm is added in Table 2.

Table 2. Required minimum embedded depth for buried pipeline as loading is applied to ground surface (Ministry of Land, Transport, and Maritime Affairs, 2010)

Pipeline Diameter (D)	Required minimum embedded depth (mm)
D ≤ 900 mm	1,200 mm
D ≥ **1,000 mm**	D ≤ and ≥ 1,500 mm

04: Page 404

Page 14 line 319: Unit weight of soils (ɤ) are corrected by actual input values used in numerical analyses in Table 4.

Table 4. Mechanical characteristics of soils used in numerical analysis

Soil types	ɤ (kN/m^3)	E (MPa)	υ	c (kPa)	ϕ (°)
Clay	**15.0**	5	0.35	10	20
Loose sand	**18.6**	15	0.3	0	25
Medium dense sand	**19.0**	25	0.3	0	28
Dense sand	**19.4**	45	0.3	0	30
Dense sand and gravel	**20.0**	120	0.25	0	35

05: Page 395 Line 22

The data used in Fig. 6 was very carefully examined. It was found that the data used for clay and loose sand was switched. Therefore, Fig. 6 is newly plotted by switching the data.

05: Page 396 Line 14

The data used in Fig. 8 was very carefully examined. It was found that the data used for clay and loose sand was switched. Therefore, Fig. 8 is newly plotted by switching the data.

Revised Manuscript based on Referee Comments – Referee #2

Page:1 (old manuscript)

Number: 1

The abstract reads more like an introduction. Please go through this and add more quantitative facts as to data used, methods applied, and conclusions.

Page 1 line 10: The abstract is changed to have quantitative facts as to data used, methods applied, and conclusions as the followings,

"Earthquake loss estimation systems in the US, for example HAZUS (Hazard in US), have been established based on sufficient damage records for the purpose of prevention and efficient response to earthquake hazards, however, in Korea, insufficient data sets of earthquakes and damage records are currently available. In this study, the earthquake pipeline damage of Korea using pipeline repair rate (RR) recommended in HAZUS (Hazard in US) was reevaluated with the degree of confidential level when RR is used without modification for the damage estimation of pipelines in Korea. The numerical analyses using commercial finite element model, ABAQUS (2006), were carried out to compare stresses and strains mobilized in buried pipelines constructed by the design criteria and construction specifications of both Korea and the US. The stresses and strain rates of both brittle and ductile pipelines, which were embedded in dense sand overlying various in-situ soils, such as clay, sand, and gravel, subjected to various earthquake loadings were examined and compared. The numerical results show that differences in the stress and strain rates are less than 10%. This implies that RR in HAZUS can be used for earthquake damage estimation of pipelines with a 90% confidence level in Korea."

Number: 2

Each of these sentences needs references. Please go through here, and the rest of the paper, and add references as appropriate whenever 'facts' are given.

Page 2 line 31: A reference is added

However, vibrations of the ground and buildings were perceived by people living in both Busan and Masan, located in the southern part of Korea, during the 2005 Fukuoka earthquake which occurred in Japan (Park et al., 2005).

End of this paragraph, please change "should be carefully examined" to "is examined in this paper" so it is clear to reader the subject of this paper.

Page 2 line 32: It is changed from "should be carefully examined" to "is examined in this paper"

In recent years, earthquakes have become frequent in Korea and thus the behavior of buried

pipelines subjected to seismic loading is examined in this paper.

Number: 3

Unclear language. Was this carried out by you, or by Wang and Cheng (1979). If by you, then please state "was carried out here". If by Wang and Chang, then start the sentence with "Wang and Chang (1979) carried out a simplified ...". "They found that the behavior..."

Page 2 lines 34, 39, 43, 47, 49 & Page 3 lines 65, 69, 72, & Page 4 lines 75, 79: The sentences have been changed by the instructions of referee's comments

Number: 4

Because of the way you have written this paragraph, it is difficult to follow who did what.
Perhaps you could try the sentences something like the following: (a) Start the paragraph with something like, "There have been a number of studies related to buried pipelines. For example, Wang and Cheng (1979) performed a simplified quasi-..." "They found..." In another study, Takada and Tanabe 91987) found... A third study by O'Rourke and Liu (199) found that... This might make it easier for the reader to separate out the studies, paragraph by paragraph.

Page 2 lines 34, 39, 43, 47, 49 & Page 3 lines 65, 69, 72, & Page 4 lines 75, 79: The sentences have been changed by the instructions of referee's comments

Page: 2 (old manuscript)

Number: 1

Please add a paragraph to this section. "This paper is organized as follows. First, the repair rate of pipelines is examined by... (Section 2). Then, ... (Section 3). ...."

Page 4 line 87: New paragraph is added as the followings,

"This paper is organized as follows. First, the repair rate (RR) of pipelines (Sect. 2) is described based on historical literature review. Second, the design criteria and construction specifications (Sect. 3) are examined for the pipelines in both Korea and the US. Then, a dynamic behavior of the pipeline using numerical analysis (Sect. 4) is evaluated by using the commercial finite element software ABAQUS (2006)."

Number: 2

I see now based on the other reviewer's comments you have defined this as 'repair rate'.

Page 1 line 14: RR is defined as "repair rate".

Page: 3 (old manuscript)

Number: 1

This is an example of a sentence with 'facts' but no reference.

Page 6 line 120: A reference is added as the followings,

The burial depth for large diameter pipelines should be greater than their diameter but, in the case that a burial depth of 1.2 m is not available due to spatial constraints associated with adjacent underground structures, the burial depth can be reduced to 0.6 m with permission from the officer in charge of roadway management (Ministry of Land, Transport, and Maritime Affairs, 2010).

Number: 2

These two sentences are each examples of sentences with facts, but no references. Please go through ALL sentences and check they have appropriate citations.

Page 6 lines 130, 132: Reference is added.

Page 6 lines 134, 135: Reference is added as the followings,

Lift thickness of 20% to 50% of the minimum diameter of a pipeline are required in Korea (Ministry of Land, Transport, and Maritime Affairs, 2010). A lift thickness corresponding to one-eighth of the minimum diameter of the pipeline or 100 mm is required in the US (OPS, 2010).

Number: 3

After this first sentence, tell the reader how the section will be organized. Or, do it at the end of this first paragraph. "Numerical modeling will first be examined (Section 4.1), followed by ....."

Page 7 line 147: New sentence is added as the followings,

Numerical modeling will first be examined, followed by dynamic behavior of the pipeline.

Number: 4

"1994 Northridge (*M* = *.*) and 1999 (*M* = *.*) earthquakes"

Page 7 line 143: Reference is added.

The applied seismic loadings were generated from real PGV time records measured at strong motion stations (SMSs) No. 24436 and CHY080 for the 1994 Northridge (M_w = 6.7) and 1999 Chi-Chi (M_w = 7.6) earthquakes, respectively.

Page: 4 (old manuscript)

Number: 1

With your numerical modelling, I do not get a feeling for how much uncertainty there is, as the diameter and thickness are varied. Is there any way to give some feeling of uncertainty for if you vary one item, how much the results in Figures 4 and 5 might change, and/or how much these will effect later measurements and discussions further down? I think this is the part of the paper I am least convinced by, in terms of sensitivity analysis of the outcomes to the starting parameters.

Main objective of this study is to examine the confidence level when RR recommended in HAZUS is directly used for the damage estimation for Korea pipelines due to seismic loading. Therefore, the numerical analyses were carried out to compare stresses and strains mobilized in buried pipelines constructed by the design criteria and construction specifications of both Korea and the US. Therefore, a sensitivity analyses based on parametric studies with respect to pipe diameter and soil thickness of pipe cover are beyond the scope of this study. However, in the future, parametric studies are recommendable to examine the behavior of pipelines subjected to earthquake loadings.

Number: 2

Related comment as previously, but now regarding Figures 6-9. Is there anyway to put some sort of 'error bars' in the x- or y-directions of Figure 6 to 9, so the reader has some idea of how much values might vary by due to inherent errors in the variables?

Error bars in y-direction associated with M(Mean) and SD(standard deviation) are inserted in Figs. 6 to 9 to show how much stress and strain vary with respect to soil conditions in given PGA.

Page: 8 (old manuscript)

Number: 1
Make beginning of each line uppercase?

Page 14 line 314: See Table 3

water depth is changed to Water depth

Number: 2
Ensure there is really a "space' between units.

Space was created by editing process in NHESS

Page: 10 (old manuscript)

Number: 1

(a) In tables and text, your units are "s" not "sec".
(b) In tables and text you use cm s^-1 not cm/sec.

Page 7 line 146: Unit is used in the text as "sec" as the followings,

Figs. 2 and 3 show the measured PGV time records of Northridge and Chi-Chi earthquakes, respectively (COSMOS, 2010). In addition to these, the virtual values of various PGAs, such as 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2g, at a period of 0.5 sec and earthquake duration of 10 secs were applied as seismic loadings

Number: 2

Add to end of sentence "with the repair rate (RR) given as a function of the peak ground velocity (PGV)."

More information in the figure caption is added as the followings,

Fig. 1. Fragility curve of buried pipelines provided by HAZUS with the repair rate (RR) given as a function of the peak ground velocity (PGV) (FEMA, 1999)

Page: 11 (old manuscript)

Number: 1

"during the 17 January 1994 Northridge (moment magnitude M_W = 6.7) earthquake"

More information in the figure caption is added as the followings,

Fig. 2. History of ground acceleration record during the 17 January 1994 Northridge (M_w = 6.7) earthquake (COSMOS, 2010)

Number: 2

date and magnitude similar to Fig. 2.

More information in the figure caption is added as the followings,

Fig. 3. History of ground acceleration record during the 21 September 1999 Chi-Chi (M_w = 7.6) earthquake (COSMOS, 2010)

Page: 12 (old manuscript)

Number: 1

This figure caption, and the next one, need to be much more 'self-standing' so the reader can figure out what the figures are without having to do a detailed reading of the text.

Explanation of the meaning of triangles and circles in x- and y- directions at boundary conditions, pipe diameter (D), depth of soil cover above the pipe (h_{B1}), bedding thickness beneath the pipe (h_{B2}) are described inside Figs. 4 and 5. And also the captions of Figs. 4 and 5 are added as the followings,

Fig. 4. Configuration of numerical model associated with pipeline and an in-situ soil depth and width of 30.5 m and 120 m, respectively

Fig. 5. Finite element mesh configuration and boundary conditions for pipelines and an in-situ soil depth and width of 30.5 m and 120 m, respectively

Number: 2

See Fig. 4, and make the figure caption much more complete. Make sure the difference in this figure for the triangles and circles are clear (remember your audience is both experts in your domain, but also intelligent outsiders in the broader community, so they will not know what the circles/triangles mean, and they will be unsure of what the scales are here, and what is being represented).

Explanation of the meaning of triangle and circle in x- and y- directions at boundary conditions, pipe diameter (D), depth of soil cover above the pipe (h_{B1}), bedding thickness beneath the pipe (h_{B2}) are described inside the figures in Figs. 4 and 5. The caption of Figs. 4 & 5 are changed as the followings,

Fig. 4. Configuration of numerical model associated with pipeline and an in-situ soil depth and width of 30.5 m and 120 m, respectively

Fig. 5. Finite element mesh configuration and boundary conditions for pipelines and an in-situ soil depth and width of 30.5 m and 120 m, respectively

Page: 13 (old manuscript)

Number: 1

See text comments, for Figures 6-9. Is there anyway to add some representation of uncertainty? I would also expand just a tad the figure captions, if you feel it would help, although these are pretty well done. For example, you could add one sentence, "Values derived from *** and ****** (see Fig. * and Section. * for further details).**

Representation of uncertainty: Error bars in y-direction associated with M(Mean) and SD(standard deviation) are inserted in Figs. 6 to 9 to show how much stress and strain vary with respect to soil conditions in given PGA.

The figure captions are added as the followings,

Fig. 6. Stress of ductile pipeline mobilized by earthquake loadings with respect to peak ground acceleration (PGA) in various in-situ ground conditions. Values are derived from finite element analysis (see Fig. 5 and Sect. 4.2.1 for further details)

Fig. 7. Strain (%) of ductile pipeline mobilized by earthquake loadings with respect to peak ground acceleration (PGA) in various in-situ ground conditions. Values are derived from finite element analysis (see Fig. 5 and Sect. 4.2.1 for further details)

Fig. 8. Stress of brittle pipeline mobilized by earthquake loadings with respect to peak ground acceleration (PGA) in various in-situ ground conditions. Values are derived from finite element analysis (see Fig. 5 and Sect. 4.2.2 for further details)

Fig. 9. Strain (%) of brittle pipeline mobilized by earthquake loadings with respect to peak ground acceleration (PGA) in various in-situ ground conditions. Values are derived from finite element analysis (see Fig. 5 and Sect. 4.2.2 for further details)