

論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Seismic Retrofit of RC Buildings with Various Energy-dissipation Devices and Elastic Steel Frames including Effect of Composite Behavior
著者(和文)	SAINGAMPANUMAS
Author(English)	Panumas Saingam
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第12115号, 授与年月日:2021年9月24日, 学位の種別:課程博士, 審査員:竹内 徹,坂田 弘安,五十嵐 規矩夫,田村 修次,西村 康志郎
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第12115号, Conferred date:2021/9/24, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Thesis outline

Ch.1: Introduction

Ch.2: Seismic regions and target buildings

Ch.3a: Composite behavior in RC buildings retrofitted using energy-dissipation devices and SF

Ch.3b: Retrofit of RC buildings with BRB and SF including effect of composite behavior

Ch.4: Retrofit of RC buildings with viscous dampers and SF

Ch.5: Experimental dynamic characterization of friction dampers and application to the seismic retrofit

Ch.6 Comparison and discussion of all retrofit dampers

Ch.7 : Conclusion

Table of contents

Chapter 1: Introduction

1.1	Background and motivation	1-3
1.2	Literature review	1-6
1.2.1	Retrofit with buckling-restrained brace	1-6
1.2.2	Retrofit with viscous damper	1-13
1.2.3	Retrofit with friction damper	1-16
1.2.4	Design methods for energy-dissipation devices retrofit	1-20
1.3	Purposes and objectives of this dissertation.....	1-25
1.4	Dissertation outline and summary.....	1-26
1.5	References	1-30

Chapter 2: Target buildings and seismic regions

2.1	Introduction	2-3
2.2	Mae Lao Earthquake and damages.....	2-4
2.2.1	Damage from Mae Lao Earthquake	2-7
2.3	Target structural buildings	2-17
2.4	Seismic design standard of Thailand.....	2-21
2.4.1	Seismic ground motion values	2-21
2.4.2	Example design for target building location.....	2-28
2.5	References	2-29

Chapter 3: Composite behavior in RC buildings retrofitted using buckling-restrained braces with elastic steel frames

3.1	Introduction	3-3
3.2	Preliminary retrofit design	3-5
3.3	Introduction of experimental retrofit specimens	3-15
3.3.1	Bare RC frame (R specimen)	3-15
3.3.2	RC frame specimen retrofitted with SF (RS specimen)	3-15
3.3.3	RC frame specimen retrofitted with SF and BRB (RSB specimen)	3-17
3.4	Numerical models simulating composite behavior	3-19
3.5	Validation of the proposed numerical models.....	3-23
3.6	Investigation of the composite behavior for multi-story structure.....	3-29
3.6.1	Definition of composite stiffness parameters	3-29
3.6.2	Introduction of the numerical building model	3-32

3.7	Design recommendation for BRB retrofit.....	3-37
3.8	Retrofit examples and analysis results	3-38
3.8.1	Retrofit design results for target building	3-38
3.8.2	Design details of the BRB members	3-40
3.8.3	Numerical model	3-41
3.8.4	Elastic modal properties	3-42
3.8.5	Modal pushover analysis (MPA)	3-43
3.8.6	Nonlinear response history analysis (NLRHA)	3-45
3.9	Discussion	3-52
3.10	References	3-53

Chapter 4: Seismic retrofit of RC buildings with viscous dampers and elastic steel frames including effect of composite behavior

4.1	Introduction	4-3
4.2	Retrofit design method	4-5
4.2.1	Required ratio of FVD loss stiffness (K''_a) to frame stiffness (K_f)	4-6
4.2.2	Required loss stiffness of the FVD ($K''_{a,i}$)	4-9
4.3	Retrofit design recommendation using viscous damper and steel frame including effect of composite behavior.....	4-10
4.4	Validation of the proposed retrofit design method.....	4-12
4.4.1	Retrofit design example	4-12
4.4.2	Three-dimensional (3-D) numerical model	4-16
4.4.3	Elastic modal properties	4-19
4.4.4	Modal pushover analysis (MPA)	4-21
4.4.5	Nonlinear response history analysis (NLRHA)	4-22
4.5	Discussion	4-29
4.6	References	4-31

Chapter 5: Experimental dynamic characterization of friction brace dampers and application to the seismic retrofit of RC buildings including effect of composite behavior

5.1	Introduction	5-3
5.2	Friction damper experiment.....	5-4
5.2.1	Test specimens	5-5
5.2.2	Test setup and loading protocol	5-6
5.3	Experimental results	5-8
5.3.1	Friction hysteresis	5-8

5.3.2	Cyclic variation of friction coefficient during continuous loading.....	5-11
5.3.3	Wear of friction material surface at end of testing	5-15
5.4	Friction coefficient dependencies	5-16
5.4.1	Cyclic loading dependence	5-17
5.4.2	Displacement amplitude dependence	5-18
5.4.3	Slip velocity dependence	5-19
5.4.4	Temperature dependence	5-21
5.4.5	Summary of experiment.....	5-22
5.5	Friction damper sizing and vertical distribution for seismic retrofit	5-22
5.5.1	Composite behavior between RC and retrofitted steel frames.....	5-27
5.5.2	Retrofit design steps.....	5-30
5.6	Validation of the proposed retrofit design method	5-31
5.6.1	Retrofit design example	5-31
5.6.2	Design of friction brace dampers	5-32
5.6.3	Numerical model.....	5-33
5.6.4	Elastic modal properties.....	5-35
5.6.5	Nonlinear response history analysis.....	5-37
5.7	Discussions	5-43
5.8	References	5-45

Chapter 6: Comparison and discussion of all retrofit dampers

6.1	Introduction	6-3
6.2	Comparison of groups (1), (2) and (3).....	6-6
6.2.1	Elastic modal properties.....	6-6
6.2.2	Modal pushover analysis.....	6-8
6.2.3	Nonlinear response history analysis.....	6-10
6.3	Comparison of groups (1), (2) and (4).....	6-59
6.3.1	Elastic modal properties.....	6-59
6.3.2	Modal pushover analysis.....	6-61
6.3.3	Nonlinear response history analysis.....	6-62
6.4	Discussions	6-104
6.5	References	6-105

Chapter 7: Conclusions

7	Conclusions	7-3
---	-------------------	-----

Appendix

	Related publications and achievements.....	A-1
--	--	-----