

برنامه چهارمین همایش ملی طراحی عملکردی سازه‌ها

۲۴ تا ۲۹ بهمن ۹۶

موضوع	سخنران	مدت زمان	توضیحات
ارزیابی و مقاوم سازی ساختمان‌های بتنی موجود و حل مثال با کمک نرم افزار SeismoBuild و SeismoStruct	Dr. Stelios Antoniou مدیر اجرایی کمپانی SeismoSoft	۲ ساعت	ارائه سمینار به زبان انگلیسی سرفصل: <ul style="list-style-type: none"> • Methods of Analyses • Checks and Acceptance Criteria • Strengthening Techniques • Evaluation of Different Seismic Retrofitting Solutions - An Example • Strengthening Interventions' Strategy • Real Strengthening Projects • Assessment of a 2-storey RC Building with SeismoBuild
طراحی عملکردی سازه‌ها فلسفه، اصول و ضرورت‌ها	جواد قدرتی	۳۰ دقیقه	کارشناس ارشد زلزله- مدرس دوره‌های طراحی عملکردی
سیستم‌های کنترلی جداساز و میراگر لرزه‌ای، کاربردها، بایدها و نبایدها	سید علی موید علایی	۳۰ دقیقه	دکتری زلزله- مدیر عامل شرکت بهساز اندیشان تهران
پنل پرسش و پاسخ	گروه سخنرانان	۱ ساعت	همراه با ارائه توضیحات تکمیلی از سایر نرم افزارهای کمپانی Seimosoft

به همراه پذیرایی و بازدید از غرفه‌های جانبی سالن همایش

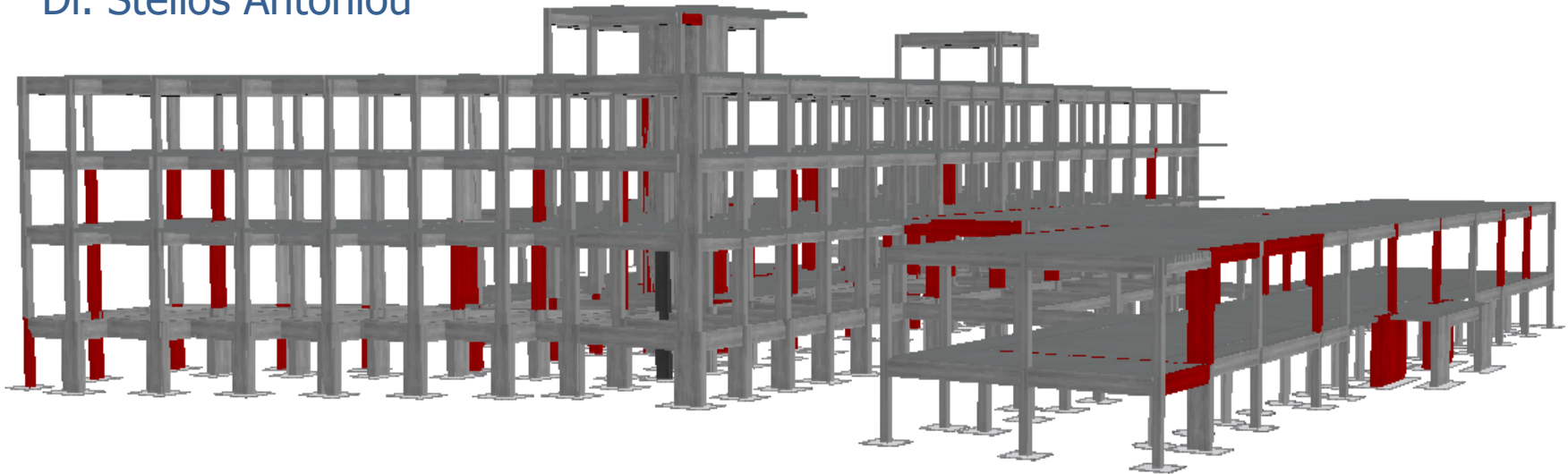
(تخفیف ویژه عرضه حضوری محصولات آموزشی ۸۰۸ مختص شرکت کنندگان در همایش)

توجه: تنها برای افرادی که بلیط شرکت در همایش خود را آنلاین از طریق وبسایت ۸۰۸ تهیه کرده‌اند پذیرش صورت می‌گیرد، ارائه پرینت بلیط جهت صدور گواهینامه الزامی است

Seismic Assessment & Retrofitting of Existing RC Structures

Using SeismoBuild and SeismoStruct

Dr. Stelios Antoniou



Presentation Summary

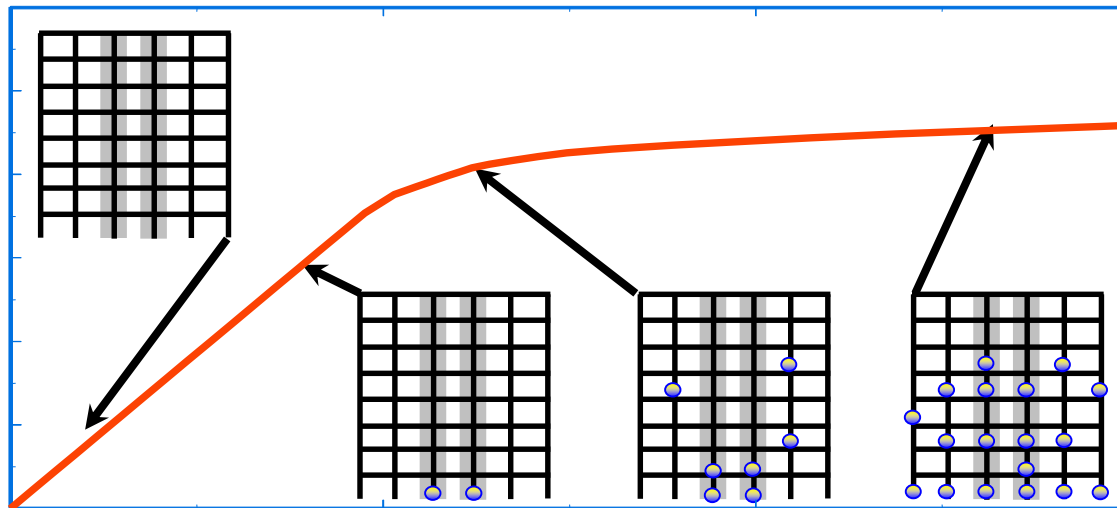
1. Methods of Analyses
2. Checks and Acceptance Criteria
3. Strengthening Techniques
4. Evaluation of Different Seismic Retrofitting Solutions - An Example
5. Strengthening Interventions' Strategy
6. Real Strengthening Projects
7. Assessment of a 2-storey RC Building with SeismoBuild



Presentation Summary

1. Methods of Analyses

- Brief description of Performance-based Engineering
- Methods of Analyses, linear and nonlinear
- Advantages and Disadvantages
- Limitations imposed by the Codes
- Guidelines on how to select method of analysis (preferred method)



Presentation Summary

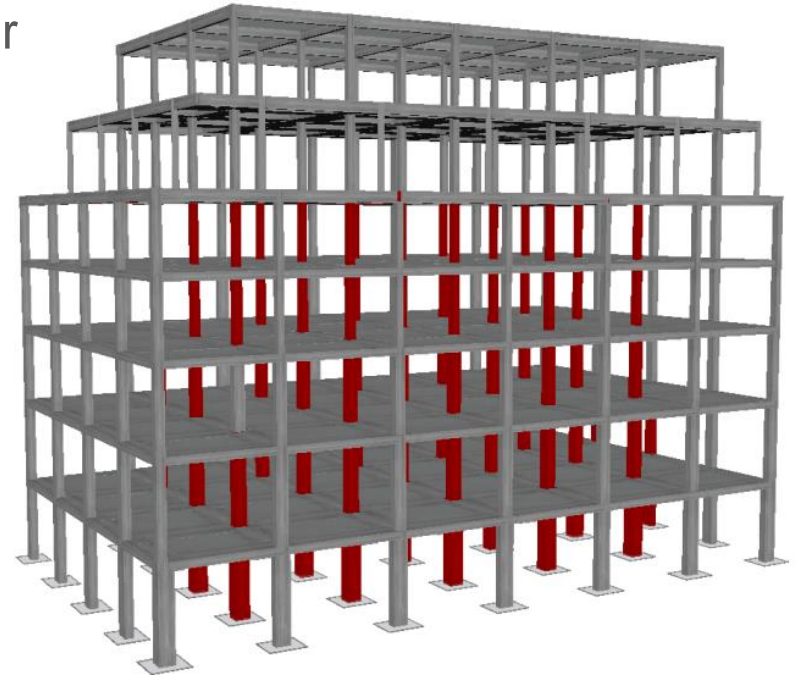
1. Methods of Analyses
2. **Checks and Acceptance Criteria**
3. Strengthening Techniques
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Presentation Summary

2. Checks and Acceptance Criteria

- Classification of Structural Members
 - Primary / Secondary
- Classification of Actions
 - Force-controlled / Deformation-controlled
- Expected vs. Lower-Bound Strengths
- Knowledge Level & Knowledge Factor
- Capacity Checks
 - Linear methods & non-linear methods
 - Main checks of the assessment



Presentation Summary

1. Methods of Analyses
2. Checks and Acceptance Criteria
3. **Strengthening Techniques**
4. Evaluation of Different Seismic Retrofitting Solutions - An Example
5. Strengthening Interventions' Strategy
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7. Assessment of a 2-storey RC Building with SeismoBuild



Presentation Summary

3. Strengthening Techniques

➤ Presentation of the Basic Strengthening Techniques

- RC Jackets
- New RC walls
- Steel Bracing
- FRP Wrapping
- FRP Laminates
- Steel Plates
- Seismic Isolation
- Resins / Mortars

➤ Effects on the Structural Response

➤ Advantages / Disadvantages

➤ When they are used



Presentation Summary

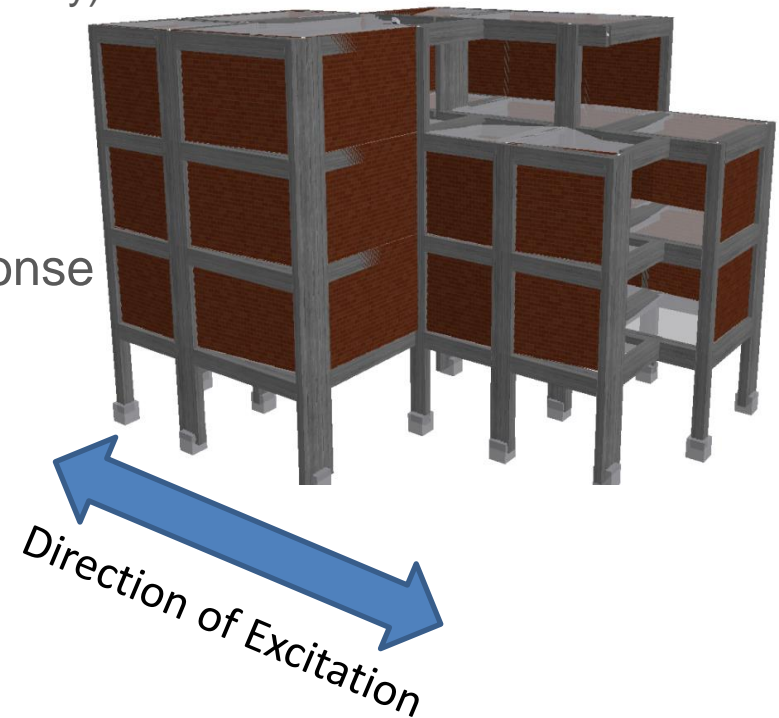
1. Methods of Analyses
2. Checks and Acceptance Criteria
3. Strengthening Techniques
4. **Evaluation of Different Seismic Retrofitting Solutions - An Example**
5. Strengthening Interventions' Strategy
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7. Assessment of a 2-storey RC Building with SeismoBuild



Presentation Summary

4. Evaluation of Different Seismic Retrofitting Solutions - An Example

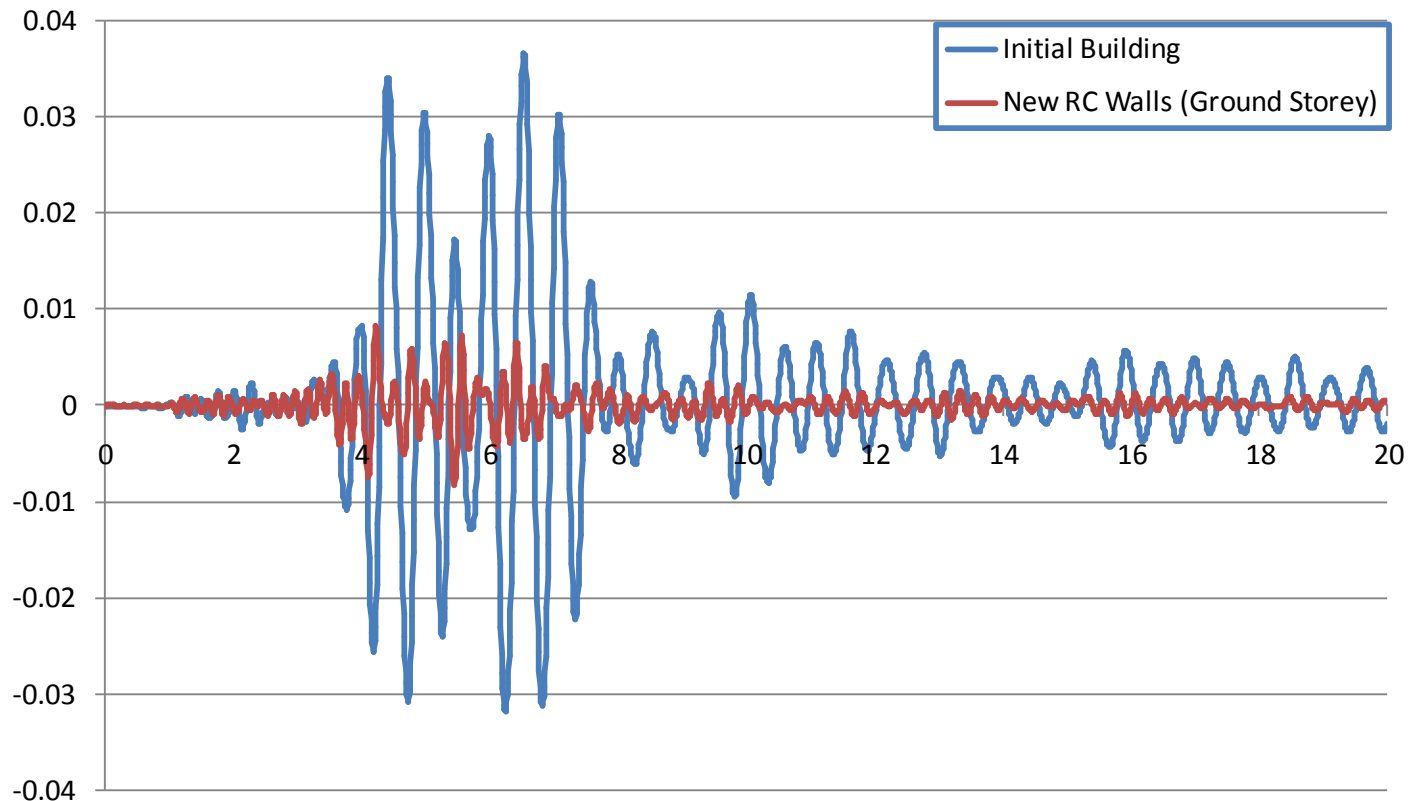
- Existing RC Building
- Different Strengthening Methods
 - Strengthening with Jacketing
 - Strengthening with RC Walls (ground floor only)
 - Strengthening with RC Walls (full height)
 - Strengthening with Braces
 - Strengthening with FRP Wrapping
- Interventions' Effect on Structural Response
- Advantages / Disadvantages
- Comparison between Methods



Presentation Summary

4. Evaluation of Different Seismic Retrofitting Solutions – An Example

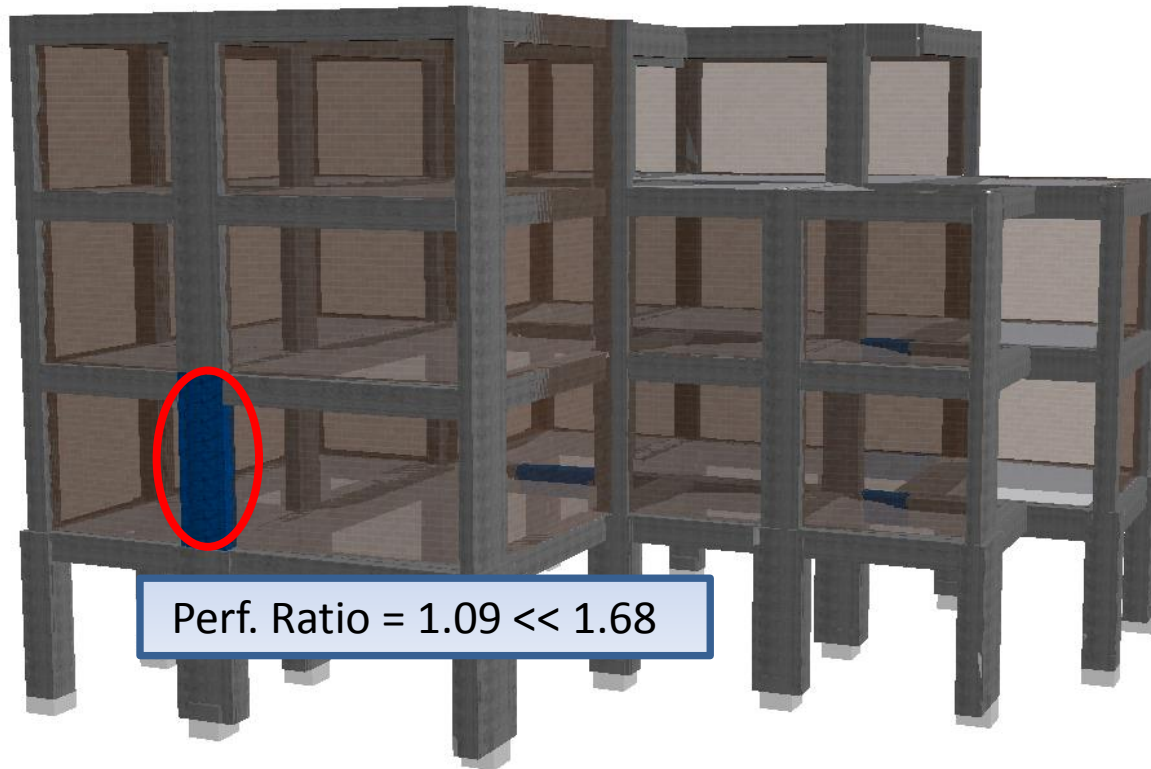
➤ Comparative Plots



Presentation Summary

4. Evaluation of Different Seismic Retrofitting Solutions – An Example

- Compare Response with/without Strengthening



Presentation Summary

1. Methods of Analyses
2. Checks and Acceptance Criteria
3. Strengthening Techniques
4. Evaluation of Different Seismic Retrofitting Solutions - An Example
5. **Strengthening Interventions' Strategy**
6. Real Strengthening Projects
7. Assessment of a 2-storey RC Building with SeismoBuild



Presentation Summary

1. Methods of Analyses
2. Checks and Acceptance Criteria
3. Strengthening Techniques
4. Evaluation of Different Seismic Retrofitting Solutions - An Example
5. Strengthening Interventions' Strategy
- 6. Real Strengthening Projects**
7. Assessment of a 2-storey RC Building with SeismoBuild



Presentation Summary

6. Real Strengthening Projects

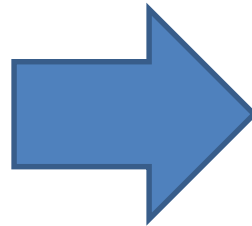
- Presentation of Several Strengthening Projects with Different Strengthening Techniques



Presentation Summary

6. Real Strengthening Projects

➤ Strengthening of Damaged Building from Recent Earthquake



Presentation Summary

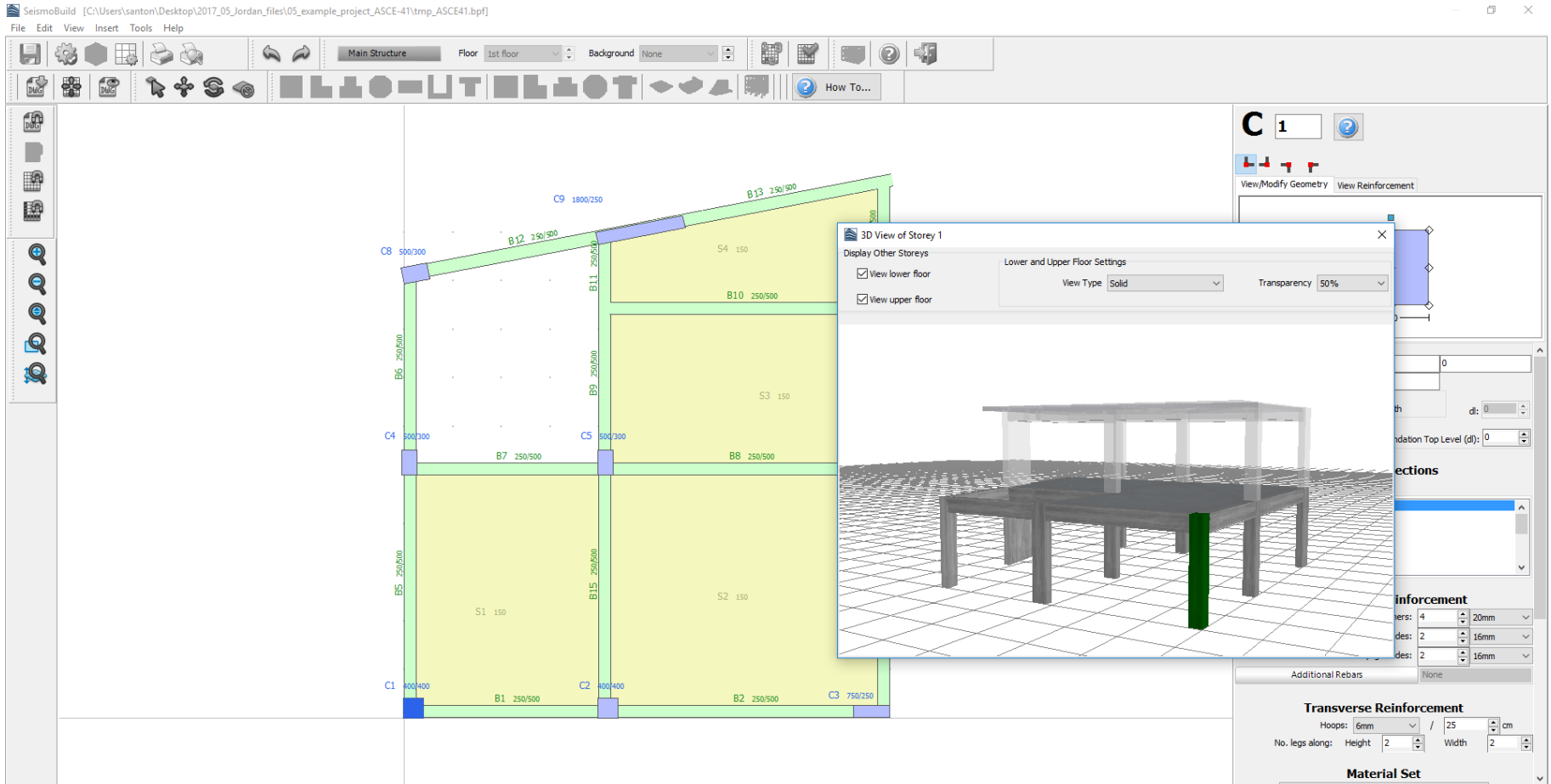
1. Methods of Analyses
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7. **Assessment of a 2-storey RC Building with SeismoBuild**



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

➤ Construct the Structural Model



SeismoBuild [C:\Users\santon\Desktop\2017_05_Jordan_files\05_example_project_ASCE-41\tmp_ASCE41.bpf]

File Edit View Insert Tools Help

Main Structure Floor 1st floor Background None

How To...

C 1

View/Modify Geometry View Reinforcement

3D View of Storey 1

Display Other Storeys

- View lower floor
- View upper floor

Lower and Upper Floor Settings

View Type Solid Transparency 50%

Reinforcement

bars:	4	20mm
des:	2	16mm
des:	2	16mm

Additional Rebars None

Transverse Reinforcement

Hoops: 6mm / 25 cm

No. legs along: Height 2 Width 2

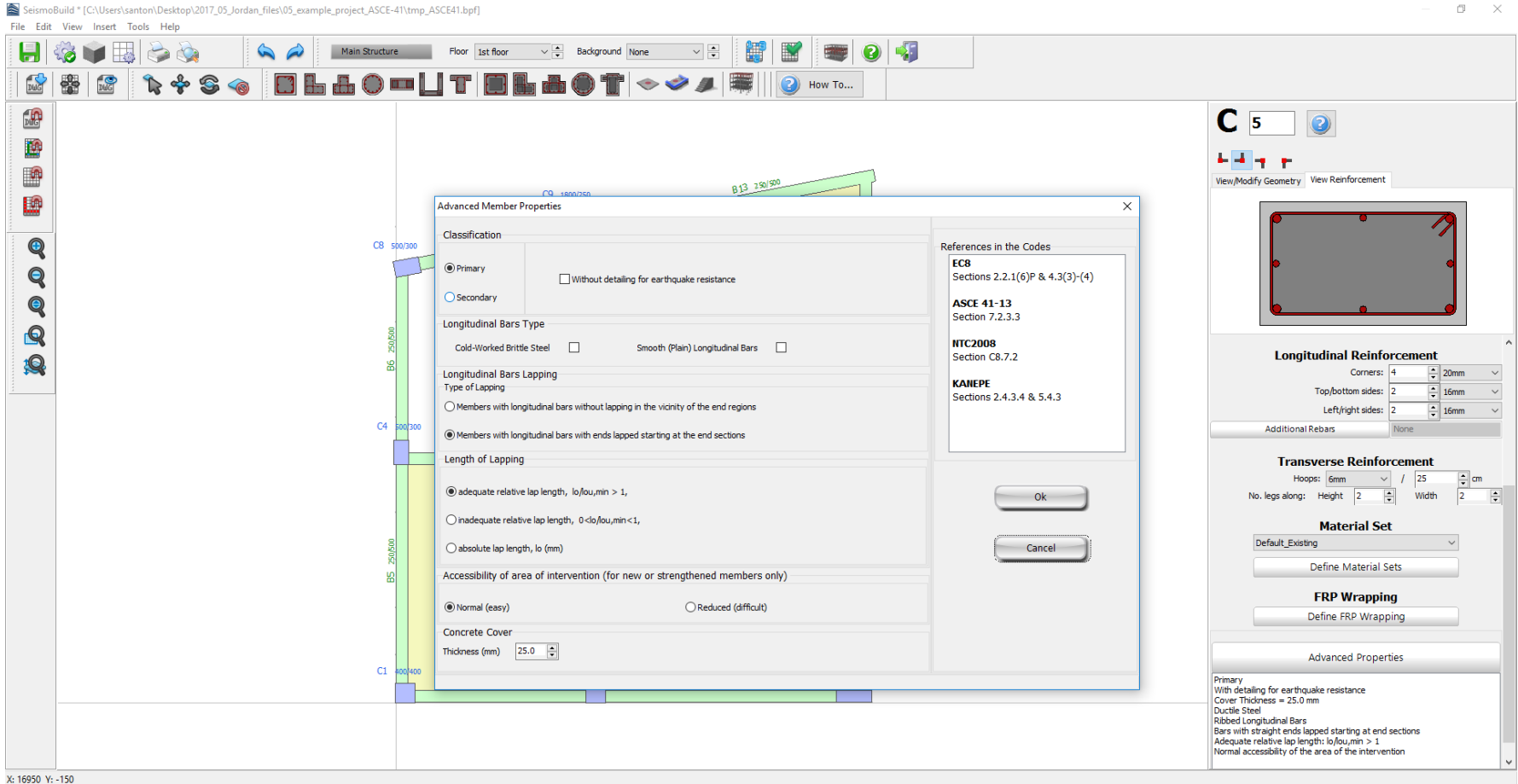
Material Set



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

➤ Input the Assessment Parameters



SeismoBuild * [C:\Users\santon\Desktop\2017_05_Jordan_files\05_example_project_ASCE-41\tmp_ASCE41.bpf]

File Edit View Insert Tools Help

Main Structure Floor 1st floor Background None

How To...

Advanced Member Properties

Classification

Primary Without detailing for earthquake resistance

Secondary

Longitudinal Bars Type

Cold-Worked Brittle Steel Smooth (Plan) Longitudinal Bars

Longitudinal Bars Lapping

Type of Lapping

Members with longitudinal bars without lapping in the vicinity of the end regions

Members with longitudinal bars with ends lapped starting at the end sections

Length of Lapping

adequate relative lap length, $l_o/l_{o,min} > 1$,

inadequate relative lap length, $0 < l_o/l_{o,min} < 1$,

absolute lap length, l_o (mm)

Accessibility of area of intervention (for new or strengthened members only)

Normal (easy) Reduced (difficult)

Concrete Cover

Thickness (mm) 25.0

References in the Codes

ECB
Sections 2.2.1(6)P & 4.3(3)-(4)

ASCE 41-13
Section 7.2.3.3

NTC2008
Section C8.7.2

KANIEPE
Sections 2.4.3.4 & 5.4.3

OK

Cancel

C 5

View/Modify Geometry View Reinforcement

Longitudinal Reinforcement

Corners: 4 20mm

Top/bottom sides: 2 16mm

Left/right sides: 2 16mm

Additional Rebars: None

Transverse Reinforcement

Hoops: 6mm / 25 cm

No. legs along: Height 2 Width 2

Material Set

Default_Existing

Define Material Sets

FRP Wrapping

Define FRP Wrapping

Advanced Properties

Primary
With detailing for earthquake resistance
Cover Thickness = 25.0 mm
Ductile Steel
Ribbed Longitudinal Bars
Bars with straight ends lapped starting at end sections
Adequate relative lap length; $l_o/l_{o,min} > 1$
Normal accessibility of the area of the intervention

X: 16950 Y: -150



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

➤ Input the Performance Objectives & Earthquake Hazard Levels

Code Requirements

Performance Levels
Analysis Type
Knowledge Level
Seismic Action
Static Actions
Checks

Performance Levels Select one or more performance levels to be used in the checks

ASCE 41-13. Table C1-1: Rehabilitation Objectives

		Target Building Performance Levels			
		(1-A)	(1-B)	(3-C)	(5-E)
Earthquake Hazard Level	50%/50 year	<input type="checkbox"/> a	<input type="checkbox"/> b	<input type="checkbox"/> c	<input type="checkbox"/> d
	BSE-1E (20%/50 year)	<input type="checkbox"/> e	<input type="checkbox"/> f	<input type="checkbox"/> g	<input type="checkbox"/> h
	BSE-2E (5%/50 year)	<input type="checkbox"/> i	<input type="checkbox"/> j	<input checked="" type="checkbox"/> k	<input type="checkbox"/> l
	BSE-2N (2%/50 year)	<input type="checkbox"/> m	<input type="checkbox"/> n	<input type="checkbox"/> o	<input checked="" type="checkbox"/> p

Select Performance Objectives

Performance Level of Operational Level (1-A) Probability of Exceedance 50% / 50 years - Return Period 72 years
Very light damage. No permanent drift. Structure substantially retains original strength and stiffness. Minor cracking of facades, partitions, and ceilings as well as structural elements. All systems important to normal operation are functional.

Performance Level of Immediate Occupancy (1-B) Probability of Exceedance 20% / 50 years - Return Period 225 years
Light damage. No permanent drift. Structure substantially retains original strength and stiffness. Minor cracking of facades, partitions, and ceilings, as well as structural elements. Elevators can be restarted. Fire protection operable.

Performance Level of Life Safety (3-C) Probability of Exceedance 10% / 50 years - Return Period 474 years
Moderate damage. Some residual strength and stiffness left in all stories. Gravity load-bearing elements function. No out-of-plane failure of walls or tipping of parapets. Some permanent drift. Damage to partitions. Building may be beyond economical repair.

Performance Level of Collapse Prevention (5-E) Probability of Exceedance 2% / 50 years - Return Period 2475 years
Severe damage. Little residual stiffness and strength, but load-bearing columns and walls function. Large permanent drifts. Some exits blocked. Infills and unbraced parapets failed or at incipient failure. Building is near collapse.

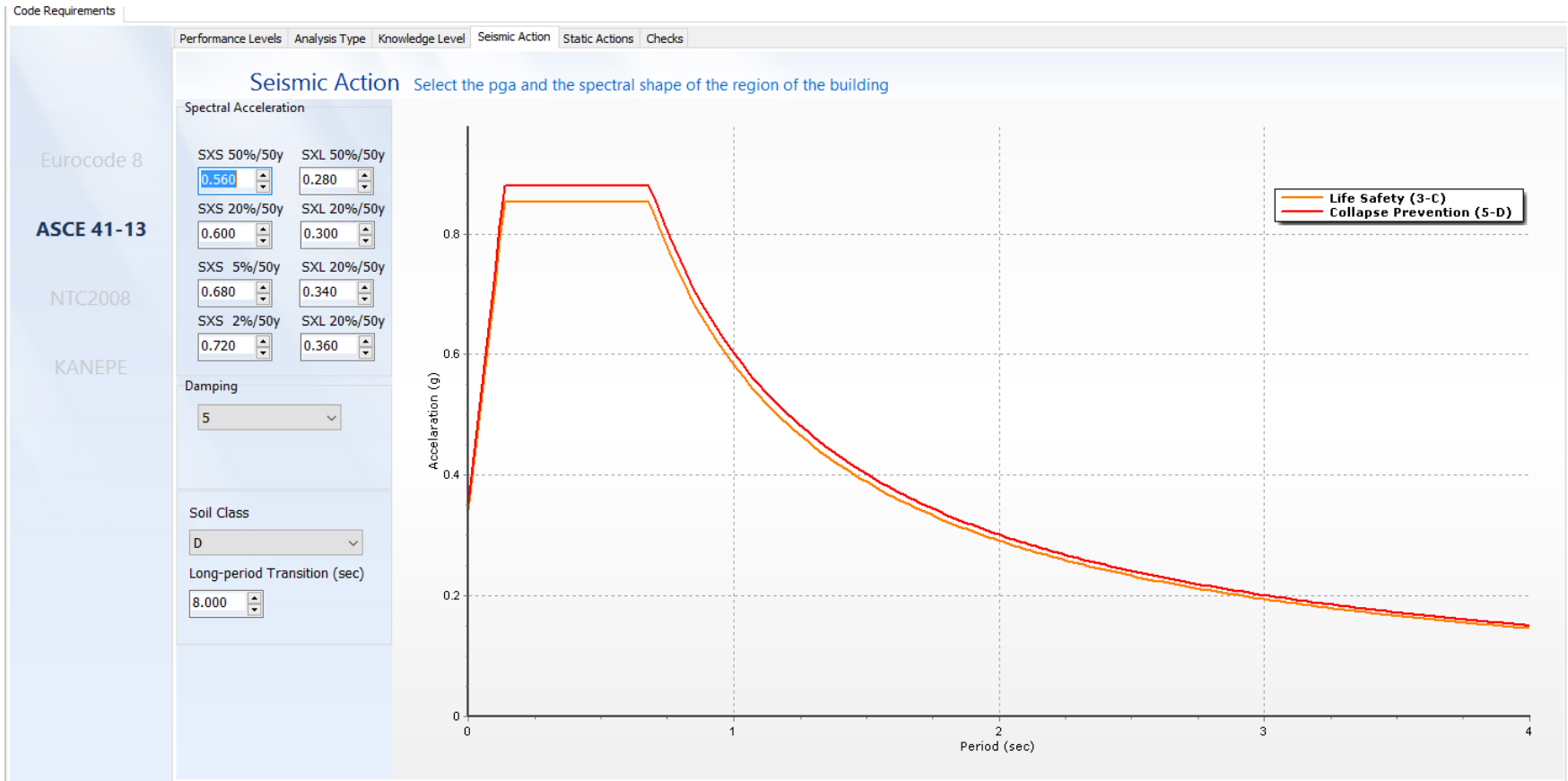
Length: m
Force: kN
Mass: tonne
Stress: kPa
Acceleration: m/sec²



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

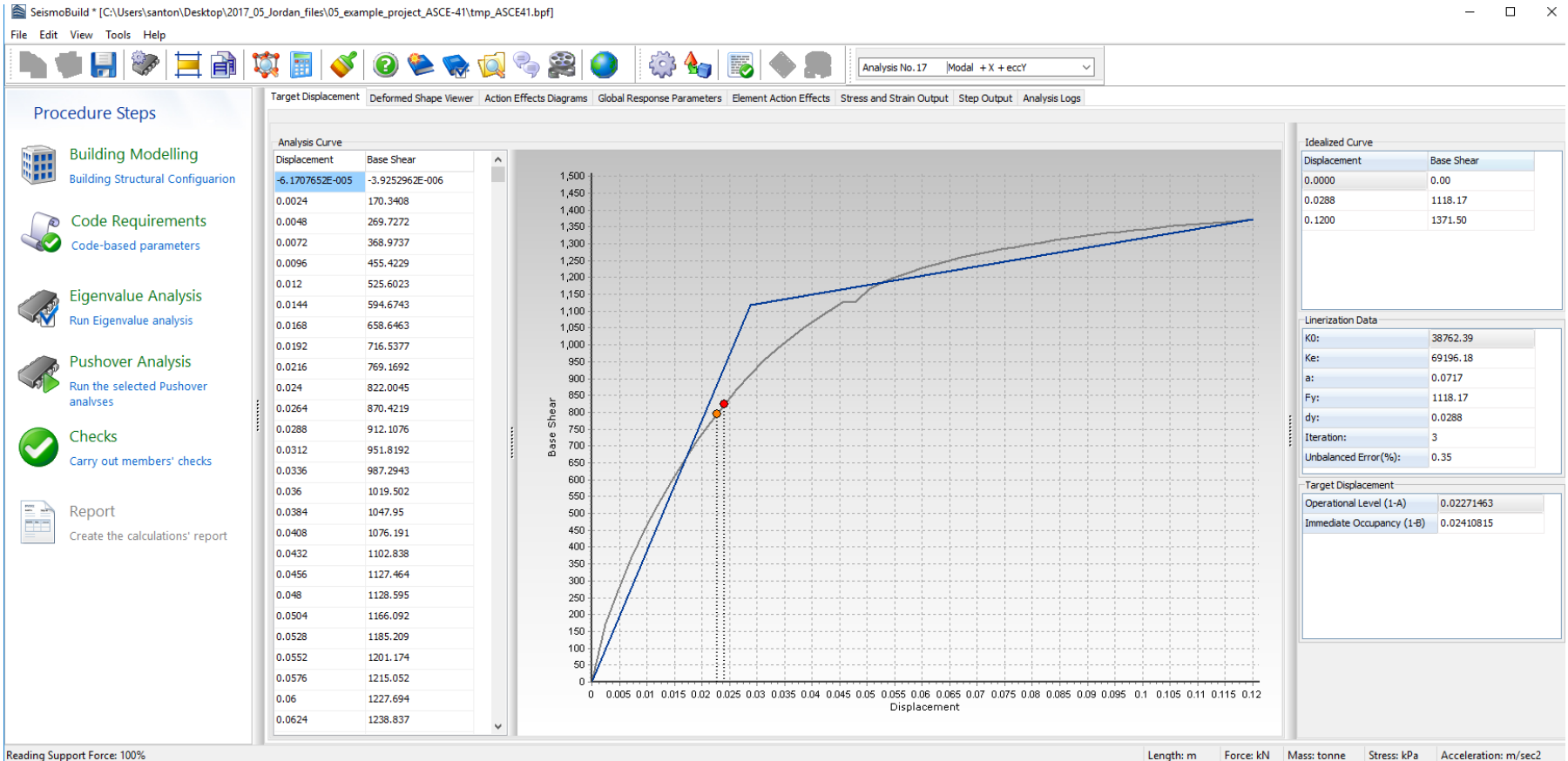
➤ Input the Seismic Action



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

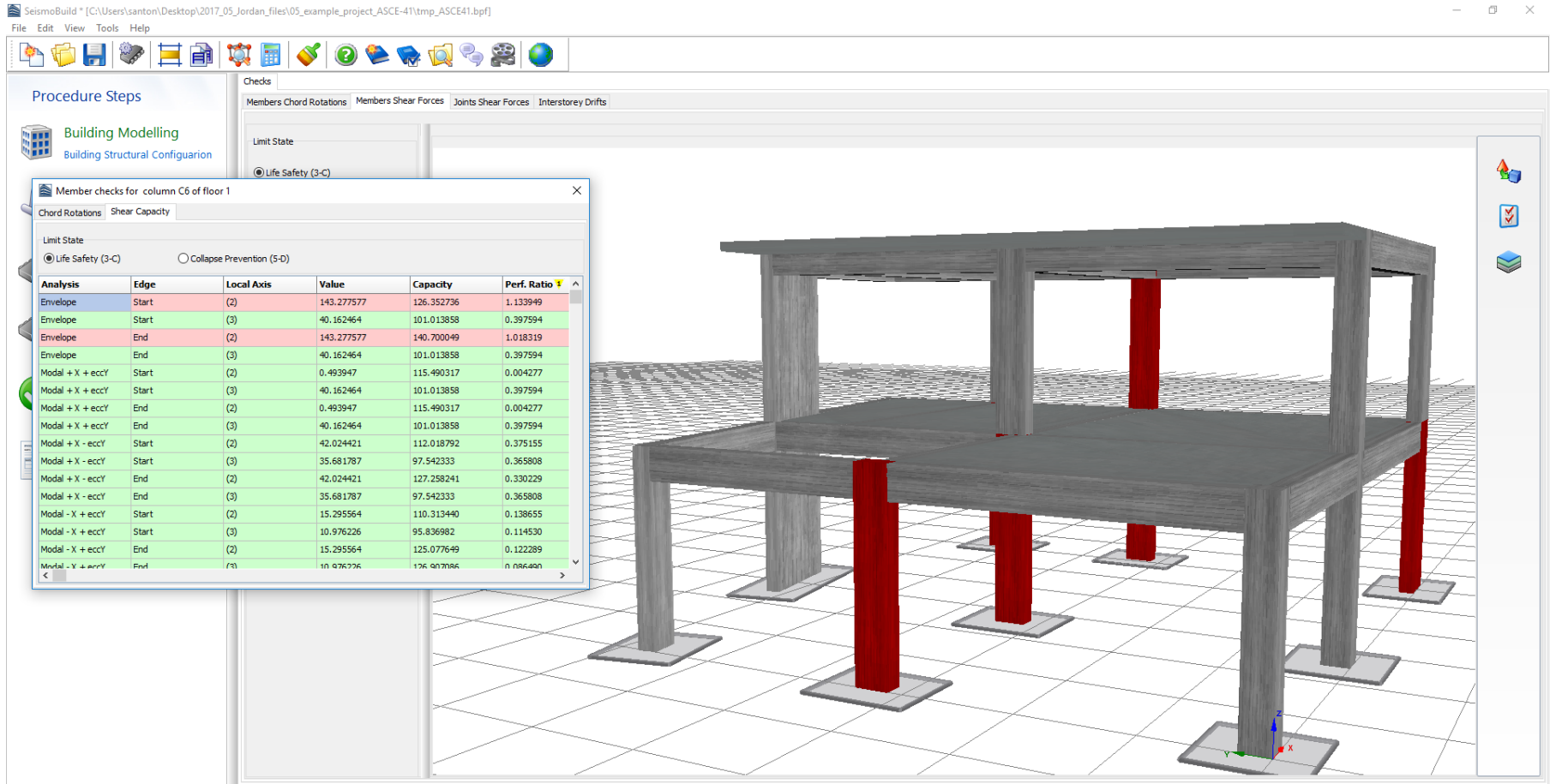
➤ Carry out the Required Analyses (Eigenvalue & Pushover)



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

► Carry out the Capacity Checks



The screenshot displays the SeismoBuild software interface. The main window shows a 3D model of a 2-storey RC building with columns highlighted in red. A dialog box titled 'Member checks for column C6 of floor 1' is open, showing a table of analysis results for various limit states.

Procedure Steps: Building Modelling, Building Structural Configuration

Checks: Members Chord Rotations, Members Shear Forces, Joints Shear Forces, Interstorey Drifts

Limit State: Life Safety (3-C)

Analysis	Edge	Local Axis	Value	Capacity	Perf. Ratio
Envelope	Start	(2)	143.277577	126.352736	1.133949
Envelope	Start	(3)	40.162464	101.013858	0.397594
Envelope	End	(2)	143.277577	140.700049	1.018319
Envelope	End	(3)	40.162464	101.013858	0.397594
Modal + X + eccY	Start	(2)	0.493947	115.490317	0.004277
Modal + X + eccY	Start	(3)	40.162464	101.013858	0.397594
Modal + X + eccY	End	(2)	0.493947	115.490317	0.004277
Modal + X + eccY	End	(3)	40.162464	101.013858	0.397594
Modal + X - eccY	Start	(2)	42.024421	112.018792	0.375155
Modal + X - eccY	Start	(3)	35.681787	97.542333	0.365808
Modal + X - eccY	End	(2)	42.024421	127.258241	0.330229
Modal + X - eccY	End	(3)	35.681787	97.542333	0.365808
Modal - X + eccY	Start	(2)	15.295564	110.313440	0.138655
Modal - X + eccY	Start	(3)	10.976226	95.836982	0.114530
Modal - X + eccY	End	(2)	15.295564	125.077649	0.122289
Modal - X + eccY	End	(3)	10.976226	95.836982	0.114530



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

Export the Deliverables (Report with checks)

Preview

50% of 418

Close

All the critical, operating or other components and other aspects, have been carried out for the software library files according to ASCE 41-13 section 10.

1. Definition Check

2. Periods Check

3. Capacity Curves and Determination of Target Displacement for selected Limit States

4. Modal Analysis Parameters

5. Capacity Curve

6. Elastic Acceleration Response

7. Target Displacement

8. Modal Analysis Parameters

9. Capacity Curve

10. Elastic Acceleration Response

11. Target Displacement

12. Modal Analysis Parameters

13. Capacity Curve

14. Elastic Acceleration Response

15. Target Displacement

16. Modal Analysis Parameters

17. Capacity Curve

18. Elastic Acceleration Response

19. Target Displacement

20. Modal Analysis Parameters

21. Capacity Curve

22. Elastic Acceleration Response

23. Target Displacement

24. Modal Analysis Parameters

25. Capacity Curve

26. Elastic Acceleration Response

27. Target Displacement

28. Modal Analysis Parameters

29. Capacity Curve

30. Elastic Acceleration Response

31. Target Displacement

32. Modal Analysis Parameters

33. Capacity Curve

34. Elastic Acceleration Response

35. Target Displacement

36. Modal Analysis Parameters

37. Capacity Curve

38. Elastic Acceleration Response

39. Target Displacement

40. Modal Analysis Parameters

41. Capacity Curve

42. Elastic Acceleration Response

43. Target Displacement

44. Modal Analysis Parameters

45. Capacity Curve

46. Elastic Acceleration Response

47. Target Displacement

48. Modal Analysis Parameters

49. Capacity Curve

50. Elastic Acceleration Response

51. Target Displacement

52. Modal Analysis Parameters

53. Capacity Curve

54. Elastic Acceleration Response

55. Target Displacement

56. Modal Analysis Parameters

57. Capacity Curve

58. Elastic Acceleration Response

59. Target Displacement

60. Modal Analysis Parameters

61. Capacity Curve

62. Elastic Acceleration Response

63. Target Displacement

64. Modal Analysis Parameters

65. Capacity Curve

66. Elastic Acceleration Response

67. Target Displacement

68. Modal Analysis Parameters

69. Capacity Curve

70. Elastic Acceleration Response

71. Target Displacement

72. Modal Analysis Parameters

73. Capacity Curve

74. Elastic Acceleration Response

75. Target Displacement

76. Modal Analysis Parameters

77. Capacity Curve

78. Elastic Acceleration Response

79. Target Displacement

80. Modal Analysis Parameters

81. Capacity Curve

82. Elastic Acceleration Response

83. Target Displacement

84. Modal Analysis Parameters

85. Capacity Curve

86. Elastic Acceleration Response

87. Target Displacement

88. Modal Analysis Parameters

89. Capacity Curve

90. Elastic Acceleration Response

91. Target Displacement

92. Modal Analysis Parameters

93. Capacity Curve

94. Elastic Acceleration Response

95. Target Displacement

96. Modal Analysis Parameters

97. Capacity Curve

98. Elastic Acceleration Response

99. Target Displacement

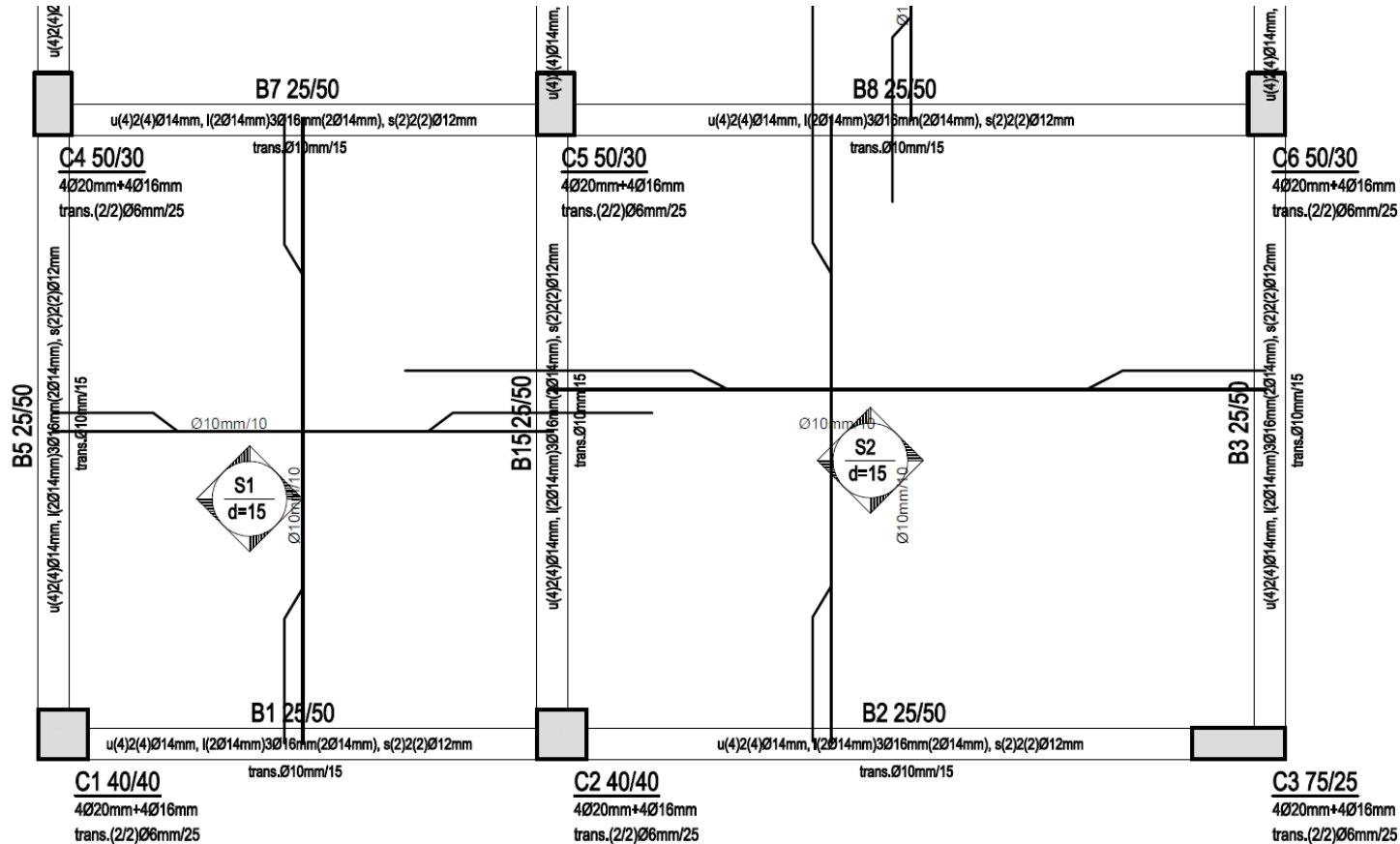
100. Modal Analysis Parameters



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

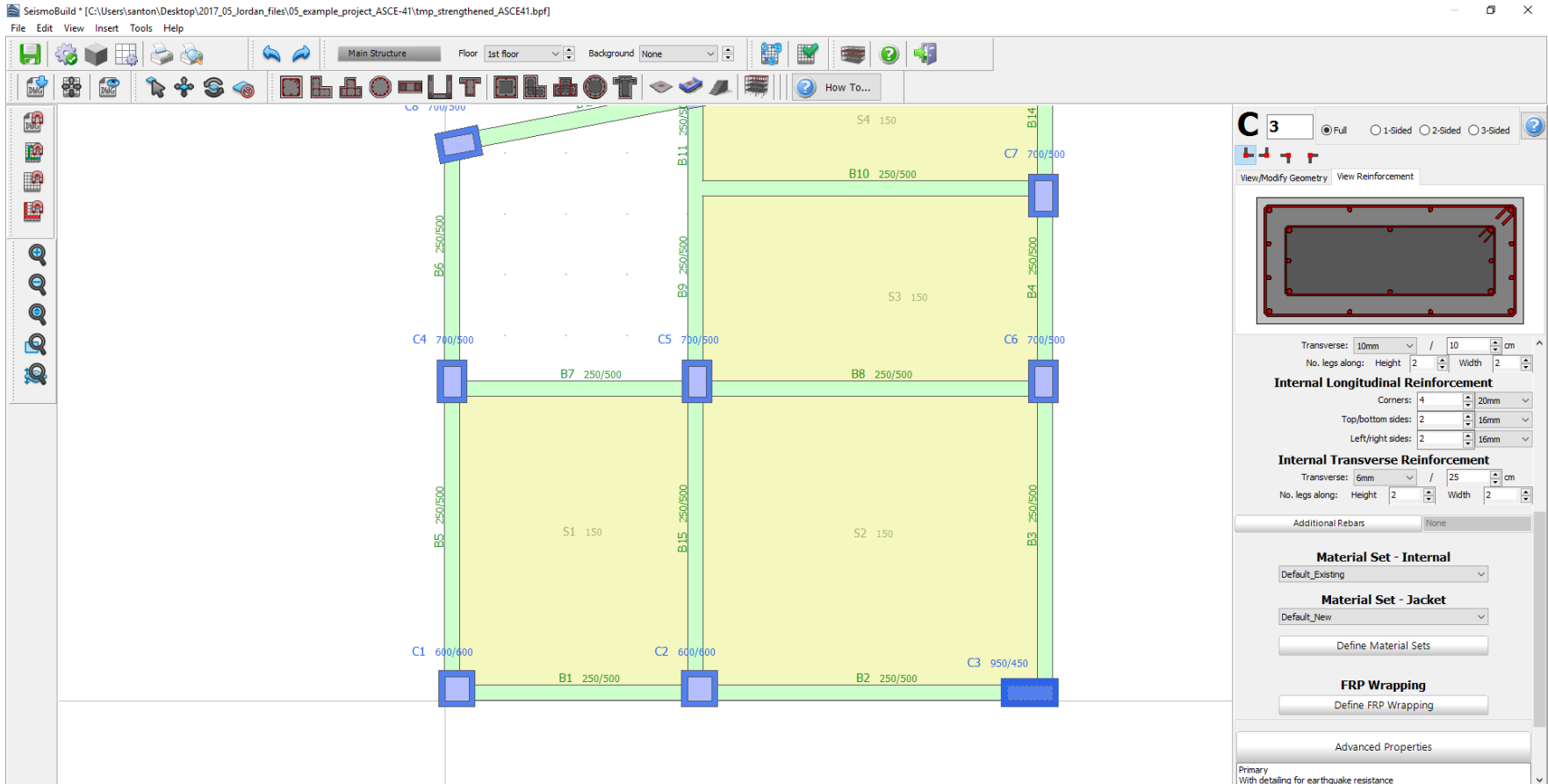
➤ Export the Deliverables (CAD drawings)



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

➤ Strengthen the building and carry out the checks again



SeismoBuild * [C:\Users\santon\Desktop\2017_05_Jordan_files\05_example_project_ASCE-41\tmp_strengthened_ASCE41.bpf]

File Edit View Insert Tools Help

Main Structure Floor 1st floor Background None

How To...

C 3 Full 1-Sided 2-Sided 3-Sided

View/Modify Geometry View Reinforcement

Transverse: 10mm / 10 cm

No. legs along: Height 2 Width 2

Internal Longitudinal Reinforcement

Corners: 4 20mm

Top/bottom sides: 2 16mm

Left/right sides: 2 16mm

Internal Transverse Reinforcement

Transverse: 6mm / 25 cm

No. legs along: Height 2 Width 2

Additional Rebars: None

Material Set - Internal

Default_Existing

Material Set - Jacket

Default_New

Define Material Sets

FRP Wrapping

Define FRP Wrapping

Advanced Properties

Primary
With detailing for earthquake resistance



Presentation Summary

7. Assessment of a 2-storey RC Building with SeismoBuild

➤ Strengthen the building, run the analysis and export the deliverables

