NEESWood Capstone Testing Report

to the

Ministry of Housing and Social Development
British Columbia, Canada

John W. van de Lindt
Colorado State University

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Executive Summary

In July 2009 a full-scale mid-rise light-frame wood apartment building was subjected to a series of earthquakes at the world's largest shake table in Miki, Japan. The test program consisted of two major phases: the building tested in the first phase had a single story steel special moment frame with six stories of wood on top, and the second phase consisted of locking down the steel story and testing the six-story light-frame wood building by itself. This report focuses on the test results for the six-story light-frame wood building. The objectives of the test program were to (1) demonstrate that the performance-based seismic design procedure developed as part of the NEESWood project worked on the full scale building, i.e. validate the design philosophy to the extent one test can; and (2) gain a better understanding of how mid-rise light-frame wood buildings respond, in general, to a major earthquake while providing a landmark data set to the seismic engineering research community. The building consisted of 1350 square meters of living space and had twenty-three apartment units; approximately half one-bedroom units and half two-bedroom units. The building was constructed over a 14 week period and lifted to the shake table where it was subjected to three earthquakes ranging from seismic intensities corresponding to the 72 year event to the 2500 year event for Los Angeles, CA. A continuous anchor tie-down system (ATS), a combination of steel rods and shrinkage compensating devices running from the bottom of building to roof level at the ends of each shear wall, was used to prevent overturning and allow the shear walls to fully engage rather than uplift. The building, known as the NEESWood Capstone building, was instrumented with just over 300 sensors and 50 LED optical tracking points to measure the component and global responses, respectively. In this report the test specimen is explained and the resulting seismic response in terms of base shears, selected wall drifts, global inter-story drifts, accelerations, hold-down forces, and roof drifts are presented. Detailed damage inspection was performed following each test and those results are summarized also. The building was found to perform excellently with little damage even following the 2500 year earthquake. The global drift at roof level was approximately 0.25 meters and maximum inter-story drifts were approximately 2% for the floor average with individual wall drifts reaching just over 3% in one corner of the building at the fifth story.

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1. Introduction and program objectives

The NSF-funded NEESWood Project was a four-year, five-university project whose objective was to develop a performance-based seismic design philosophy for mid-rise woodframe construction. The project began in 2005 and, by the end of 2006, the benchmark testing of a two-story house had taken place at the University at Buffalo's SEESL shake table facility. This test included several shear walls designed with fluid dampers during one phase of testing. A series of sub-assembly tests on shear walls with toggle-braced damping systems followed in 2008. From 2005-2008, non-linear time history analysis software was developed that was based on existing concepts and software, and improved upon as part of the NEESWood effort. This software package, called SAPWood (Pei and van de Lindt, 2007, 2008), had the dual purpose of being a research and design tool for later testing within the project as well as being available for use by practitioners. It was extended to include six degrees-of-freedom at each story and tri-axial excitation, as well as the inclusion of response modification devices such as base isolation. From 2006-2008, the Direct Displacement Design (DDD) approach (Pang and Rosowsky, 2007) was extended to multi-story woodframe buildings, which is a key outcome of the project. The DDD approach was also extended for application to woodframe buildings with sliding seismic isolation systems. In addition, the potential for enhanced performance of woodframe buildings was evaluated via shaking table tests of a half-scale base-isolated two-story building. From 2007-2009 the effect of design code changes on societal risk were investigated within the project by using Los Angeles, CA as a test bed. Finally, in order to validate the DDD approach, the world's largest shake table test was conducted at Japan's E-defense laboratory in collaboration with numerous researchers and industry participants from the U.S., Canada, and Japan. The 1350 square meter (14,000 sq ft), six-story building was designed using the DDD concept, the development of which was completed in 2008. Shear transfer and continuous steel rod holdowns were designed based on a specified non-exceedance probability using SAPWood simulation results. The building, termed the Capstone building, was subjected to three levels of seismic intensity including a design-basis earthquake (DBE) and a maximum credible earthquake (MCE).

The NEESWood Capstone wood phase objectives were:

Objective 1: To confirm that a representative mid-rise woodframe structure designed using the NEESWood PBSD philosophy satisfies the performance objectives, as pre-defined during the design process. These performance objectives seek to limit damage and losses while protecting life safety.

Objective 2: Provide a general understanding of the behavior of a mid-rise woodframe structure similar to those currently in place in the Western U.S. and provide a full-scale data set for verification and calibration of nonlinear dynamic models.

2. Construction of test building

General contractor Maui Homes USA based in Honolulu, HI, served as the contractor for construction during the project. Japanese carpenters were hired to perform the construction. There are significant differences between Japanese style wood residential construction (mostly traditional style post-and-beam configuration; their light-frame wood is closer to East coast style construction with some additional hardware) and North American light-frame wood construction, thus training as well as careful construction monitoring and quality control measures were carried out during the construction process. The ultimate construction objective was to make sure the as-built structure reflects the intentions and details in the performance based seismic design procedure. In order for the Japanese carpenters to be able to construct the shear walls and other details correctly, detailed stick drawings for every wall segment in the building were developed by the Colorado State University team.

The design of the building was not based on an existing design code but rather through the performance-based seismic design method developed in the NEESWood project combined with numerical simulation using SAPWood. However, the construction of the wood frame stories was similar to a typical construction process in North America. The difference between the Capstone structure and a typical multi-story wood frame building in essence lies in the shearwall configuration and the detailing. Specifically, the shear wall nail schedules were determined using direct displacement design such that the peak inter-story drift in the building did not exceed 4% under a Maximum Credible Earthquake (MCE) (Return Period = 2500 years) for the city of Los Angeles, CA, 80% of the time, i.e. a non-exceedance probability of 0.8. This in essence resulted in walls with approximately twince the capacity of a typical building. However, the DDD procedure distributed this stiffness height-wise throughout the building differently than force-based design methodologies.

Shear walls in Capstone building used mostly 2x6 framing. The lower three stories of the building were framed using DFL-North and the upper three stories using SPF-1650. All sill plates under shear walls were framed with DFL-N. The nail schedule was mostly 2"/12" or 3"/12" in the lower floors. Some of the walls were also sheathed on both sides (double sided) with OSB. Incorporation of a new wall type was also investigated in the project. A double Midply wall system designed to handle high shear demand that exceeds the capacity of traditional shear walls was included. Also because of the high shear capacity of shear walls, high strength shear screws were used at the top and sill plates of the shear walls instead of bolts. These SDS screws had a tested ultimate capacity of approximately 4.45 kN (1 kip) per-connector in shear. Figure 1 shows the test building under construction.

Some of the shear walls in the lower stories had very substantial compression stud packs consisting of numerous 2x6 studs lumped together at the ends surrounding the hold-down runs as shown in Figure 2. These studs were designed to resist the compressive load induced by the racking behavior of shear walls as well as gravity. Some of these stud packs interfered with the installation of shear connectors on the top and sill plates of the shear walls. In order to resolve this conflict, some of these stud packs were installed via toe-nailing after the walls were erected in place with the top and sill shear connectors already installed.

Fig. 1. Construction of shear wall systems in Capstone building with the double Midply wall shown top, right

Fig. 2. Compression stud packs in bottom wood story shear walls

Continuous tie-down systems known as Anchor Tiedown Systems (ATS) were utilized for every shear wall in the specimen. These ATS rods ran through the stories and integrated individual shear walls into shear wall stacks. The system is more effective in controlling uplift (overturning) of the wall systems than traditional hold-down systems and is typically necessary for wood frame construction in excess of three stories. Figure 3 shows a close-up of the ATS installed in a wood shear wall including a view of it passing through the floor diaphragms with coupler nuts and take-up devices on each side.

Fig. 3. The ATS system used for shear wall uplift control

After the ATS system was installed, the sheathing panel for the shear wall was attached and nailed off following the nailing pattern specified in the design. Then drywall boards (gypsum wall board, GWB) was attached with drywall screws at 0.4 m (16 in) spacing (including top and bottom, i.e. not a floating GWB style as is sometimes used). The ceiling GWB was also installed since the GWB contributes to structural stiffness and mass. Finally GWB was tape-and-mudded to represent realistic construction practice and allow for accurate and realistic damage inspection. The construction quality of the shearwalls in the building was closely monitored during the construction process. Since the shear walls are the lateral force resisting components in the building, it was very important to make sure the nailing pattern, stud lay out, anchor tie-down system, and the shear transfer details at the top and sill plates were correctly constructed. Shear transfer was primarily achieved with 150mm long 7mm diameter wood screws shown being countersunk into the Midply wall sill plate in Figure 4. As each wall was erected, the stud layout and shear connection for the top and sill plates were checked. Then the ATS rods were also installed and checked. Finally the sheathing panels were applied and the nail pattern was inspected. This process was performed for every structural wall in the building. Inspection occurred prior to completion of the specimen, and when sheathing nail schedules were found to be incorrect they were wither replaced or nails added to the appropriate line in the panel.

During each stage of construction, project PI Dr. John W. van de Lindt travelled frequently to Japan and conducted the most critical part of the quality inspection. During the construction, graduate student researchers from Japanese universities sent daily reports on the building and particularly the shear wall construction with detailed wall configuration check sheets developed by CSU design team.

Fig. 4. Installation of high strength shear connector on the double Midply sill plates

3. Shake table test program

Shake table testing of a building the size of the Capstone test specimen necessitated the use of the E-Defense shake table in Miki City, Japan. This shake table is the largest tri-axial shake table in the world with a payload capacity of 1200 tons (2.5 million pounds) and the ability to reproduce the largest historical records from the Kobe and Northridge (and other) earthquakes. The facility was built following the 1995 Kobe earthquake and opened in 2004. The concrete reaction floor is more than 60 ft (18m) in thickness. During construction, the volume of concrete used throughout made it more economical to build a concrete plant on site. The full-scale NEESWood Capstone test was the first U.S. led test conducted at E-Defense and represents the largest building ever tested on a shake table. Figure 5 shows a picture of the E-defense facility shortly after it opened in 2004.

Fig 5. Aerial image of the E-Defense facility in 2004.

The shake table is shown in Figure 6 from the first floor balcony. It is 15m x 20m in plan and has the ability to move tri-axially in either acceleration or displacement control. For safety it was necessary to have approximately one meter clear space around the perimeter of the shake table, so the floor plan of the Capstone structure was selected to maximize the usable space of the shake table. For the installation of the test specimen on to the table, it was critical to align the walls (and steel frame under the walls) with the shake table bolt pattern.

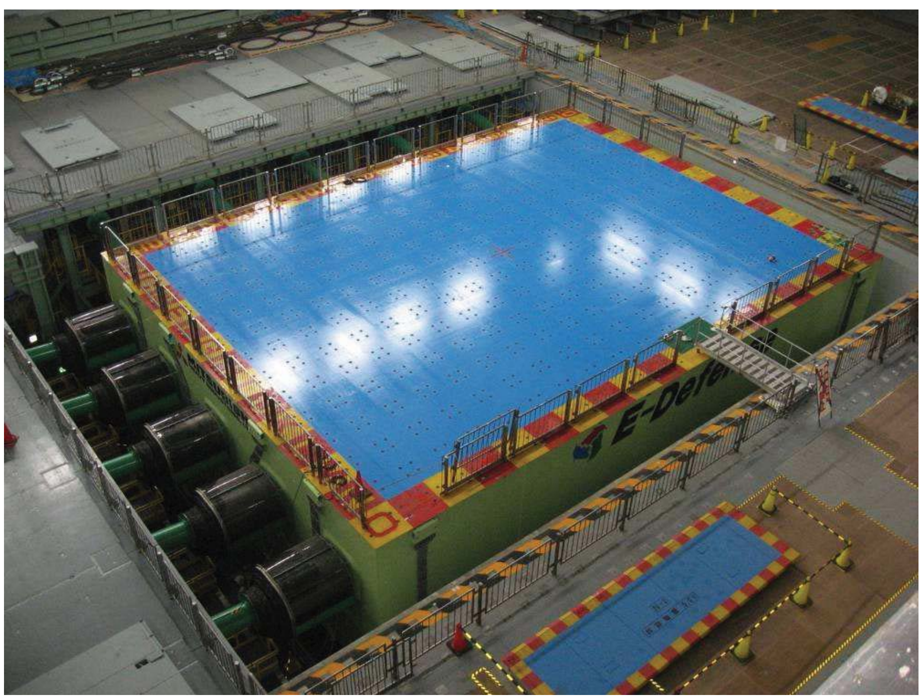

Fig 6. E-Defense shake table with actuator CV joints shown exposed on left side

The wood building was approximately 18m x 12m (60ft x 39ft) in plan view and about 17m (56 ft) tall. The elevation views, presented in Figure 7, show the significant openings on all sides of the building requiring shear wall stacks in many locations. The floor plan for the first story is shown in Figure 8a and consisted of two small one-bedroom units (Unit A) and two two-bedroom units (Unit B). The floor plan for stories two through five were the same as story one with only a slight change to unit A since no entrance door to the building was needed at those levels, and is shown in Figure 8b. The top story, story 6, is shown in Figure 8c, and was modified from the other stories to include one large two-bedroom unit (Unit D). This change in floor plan meant some of the shear walls in story 5 did not extend into story 6. For reference, the short direction of the building is designated as the X direction and the long direction as the Y direction.

Fig.7. Elevation views of the six-story test specimen

Wood shear walls were designed as stacked wall systems with a combination of steel rod hold-downs (ATS) with mechanical shrinkage compensating devices at each end to prevent overturning, reduce uplift, and remove slack from the tie-down system that would otherwise develop from in-situ reductions in wood moisture content and natural settling of the structure. Figure 9 shows a schematic of a typical 2x6 wood shear wall in the first story and details for each wall in the Capstone building can be found in the forthcoming NEESWood project report by Pei et al (2009). The design details of the building were quite extensive and only a basic description of the structural configuration is provided here for brevity. Each shear wall stack included glulam beams as shear collectors in between stories. Floor systems were made up of standard 18mm (23/32 inch) T&G Oriented Strand Board (OSB) with wood I-joists that were hung on the glulam beams with nailed metal hangers. The glulams were fully supported by shear walls except in one line between the elevator shaft and stairwell where they acted as beams since no bearing and/or shear wall was present. Wood shear walls had 12mm (15/32 inch) OSB on either one or both sides depending on the design requirements. Nail spacing ranged from sheathing panel exterior nail spacing of 50 mm (2 in) to as large as 152 mm (6 in), with a constant field nail spacing of 300 mm (12 in) for all walls. Because there were many shear walls in the Capstone building, it is not possible to shown the details of each shear wall. Shear transfer from the wall to the floor system was achieved using either a nailed channel or two lines of self tapping screw, i.e. SDS screws.

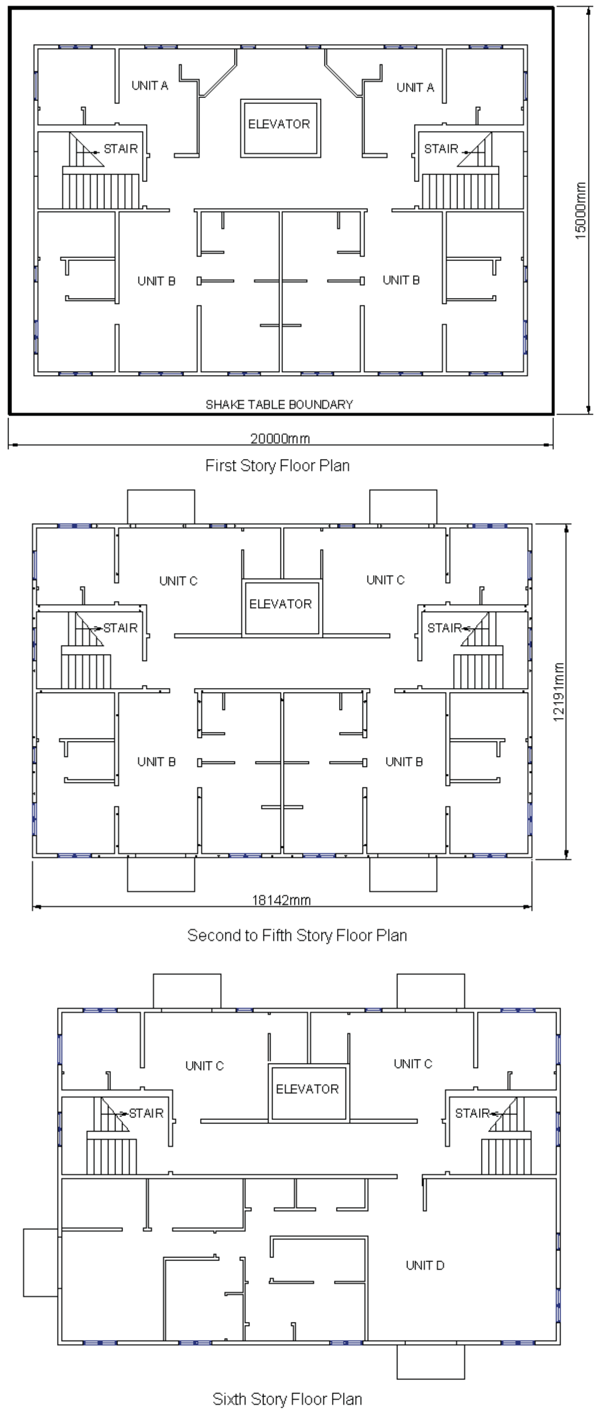

Fig. 8. Floor plans for story 1 (Fig 8a), story 2-5 (Fig 8b), and story 6 (Fig 8c)

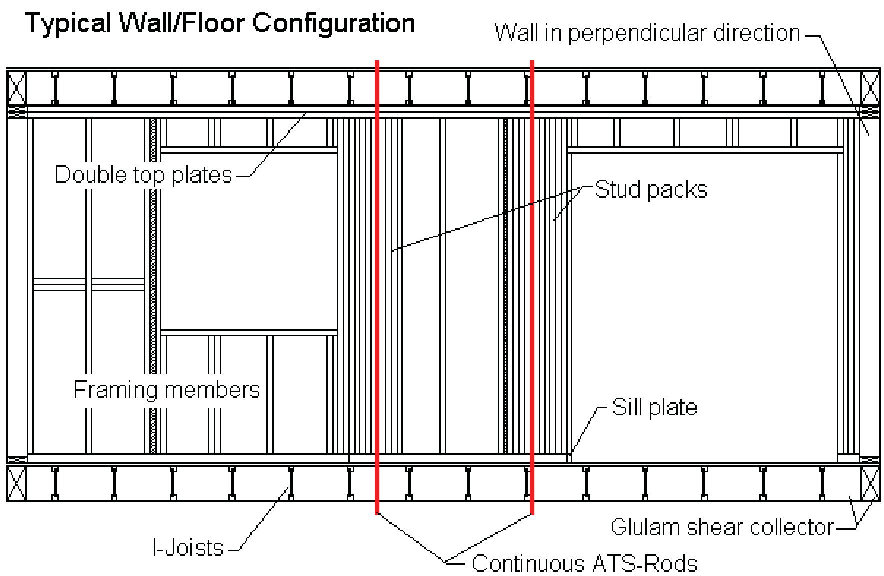

Fig. 9. Typical wall details in the Capstone building

Gypsum wall board (GWB) was installed on all walls and ceilings with tape and putty on all joints except the wall-to-ceiling joints and corners. Finishing as many joints as possible was desirable in order to provide realistic damage inspection results.

In addition to the as-built dead load, seismic mass was added to each story in the form of steel plates in order to bring the total floor seismic mass to a realistic level thereby accounting for all the insulation, gypcrete flooring, exterior finish, plumbing, HVAC, and floor finishes. The weight of the building was carefully calculated based on the construction materials used. Then the added steel plates were placed during the construction of each story and fastened to each floor and the roof.

The completed specimen standing on the shake table ready for testing is shown in Figure 10.

Fig. 10. Photograph of the 14,000 ft^2 Capstone test specimen ready for testing on Japan's E-Defense shake table

The seismic test program consisted of multiple shake table tests during three separate test days. As mentioned, during the first test day a steel special moment frame (SMF) at the base of the building was not braced and therefore participated in the testing. Then the SMF was fully braced for the tests focused on the response of the six-story wood frame building. The Northridge ground motion recorded at the Canoga Park station was used throughout the tests with different scale factors. Figure 11 shows the spectral accelerations in the X, Y, and Z directions of the un-scaled Canoga Park record, with the Y-component (which has a higher PGA value) applied in the long direction of the building. The shear capacity of the building was the same in both directions by design. The ground motion was scaled to the peak ground acceleration levels listed in Table 1 to represent seismic hazard levels with 50%, 10%, and 2% probability of exceedance in 50 years, which corresponds to return periods of 72, 475, and 2500 years, respectively for the city of Los Angeles, CA.

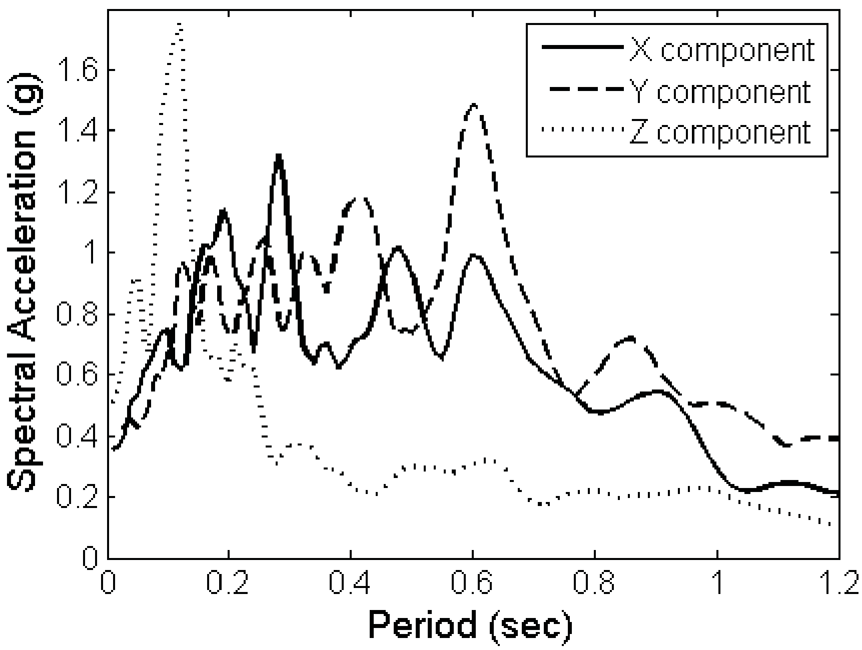

Fig.11. Un-scaled pseudo-acceleration response spectra for the Canoga Park recording of the 1994 Northridge earthquake (5% damping)

Table 1. Peak ground accelerations for the Canoga Park record

Northridge Canoga Park		Seismic Test		
		Level 1	Level 2	Level 3
Hazard level		50% 50 years	10% 50 years	2% 50 years
Scaling factor		0.53	1.20	1.80
PGA (g)	X	0.19	0.43	0.64
	Y	0.22	0.50	0.76
	Z	0.26	0.59	0.88

The NEESWood Capstone test specimen represents the largest building ever tested on a shake table. It was instrumented with over 300 channels of strain, deformation, and acceleration measurements using a high speed data acquisition (DAQ) system at Japan's E-defense. In addition to these conventional measurement devices, absolute displacement measurements were obtained using 50 three-dimensional optical tracking light emitting diodes (LED) attached to the exterior of the building whose motion during the test was captured and processed using a 3D motion tracking system consisting of multiple high-speed cameras and related software. A brief summary of all the instrumentation is listed in Table 2.

Table 2. Summary of instrumentation

Measurement	Location	Type	Number
Absolute acceleration	Each Floor	3D-acceleration	38
Diagonal shear wall drift	Selected shear walls	String Potentiometer	33
Out of plane diaphragm deformation	Third floor diaphragm	String Potentiometer	13
Shear wall end stud uplift	Selected shear walls	String Potentiometer	8
ATS hold-down strain	Selected shear walls	Strain Gage	78
Absolute displacement	Building exterior	3D Optical tracking	50

Because of the size of the building, it was not possible to find a fixed reference to instrument the absolute displacements of the structure, i.e. a frame beside the shake table. Therefore, an optical tracking measurement system was employed in the test program to capture the building movement with 50 LED light markers attached to the exterior of the building at each diaphragm level. The location of these markers is shown in Figure 12. There were no markers on the back side of the building due to camera limitations.

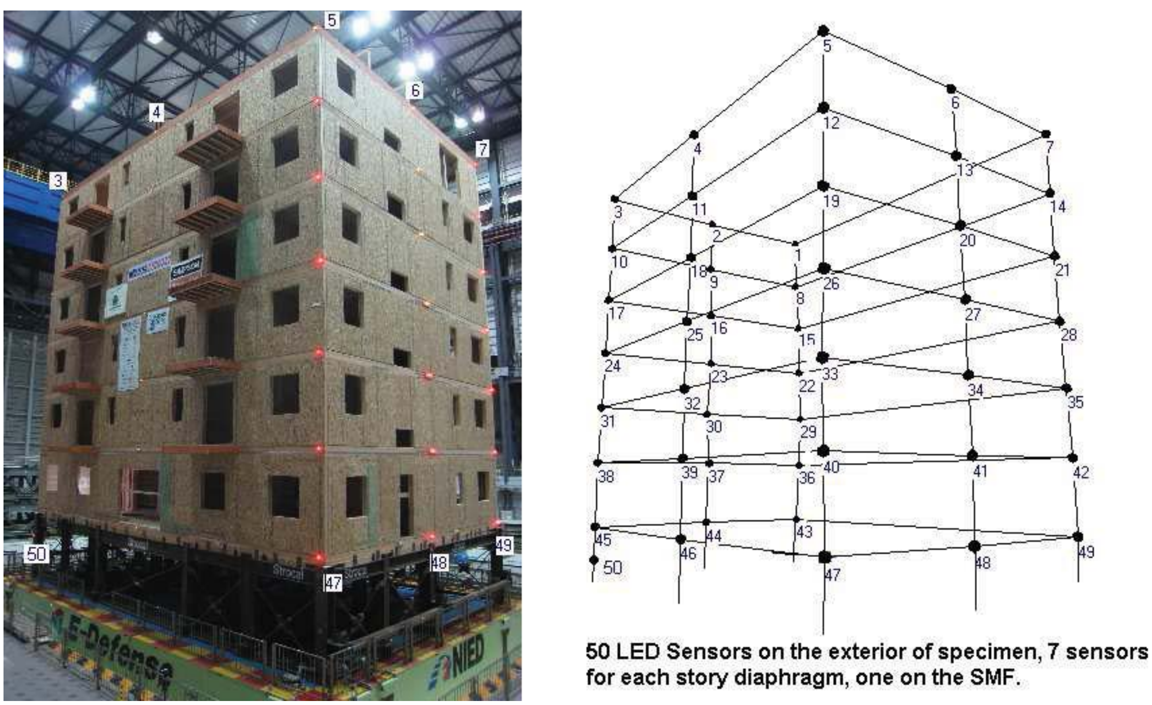

Figure 12. LED sensors for optical tracking of absolute displacements on the exterior of the specimen

White noise excitation was input in each direction of the building in order to identify the natural periods of the specimen before and after each seismic test. There was no significant change in the building fundamental period between shakes within the test program. The natural period of the building was approximately 0.49 sec. The building period under the white noise excitation in both directions agreed well with one another indicating a similar stiffness for both directions, which was consistent with the performance-based seismic design approach which was intended to provide the same stiffness and strength in both directions for the specimen.

The averaged displacement at the centroid of the floor diaphragm can be estimated based on the measurements from seven optical tracking markers for each floor. The maximum roof displacements relative to the shake table were measured to be 60mm, 140mm, and 211mm for seismic intensities 1, 2, and 3 respectively. The maximum displacement occurred in the long direction of the floor plan, namely the Y direction. The building deformation shapes at the point in time of the maximum roof displacement levels in the X and Y directions are presented in Figure 13. The shape of the deformed grid was generated directly from the optical tracking sensor measurements and is exaggerated for clarity. Although the building was designed to be symmetric and added seismic mass was distributed approximately uniformly over the building floor plan, torsional response was clearly observed during testing. The torsional response was synchronized with the lateral response of the building, which means the point in time at which the torsion reached a maximum value is very close to the occurrence of the maximum value of the lateral response, as one might expect. Due to the presence of torsion, the maximum inter-story drift of some shear walls at the upper levels near the building corners slightly exceeded 3% during the level 3 seismic test.

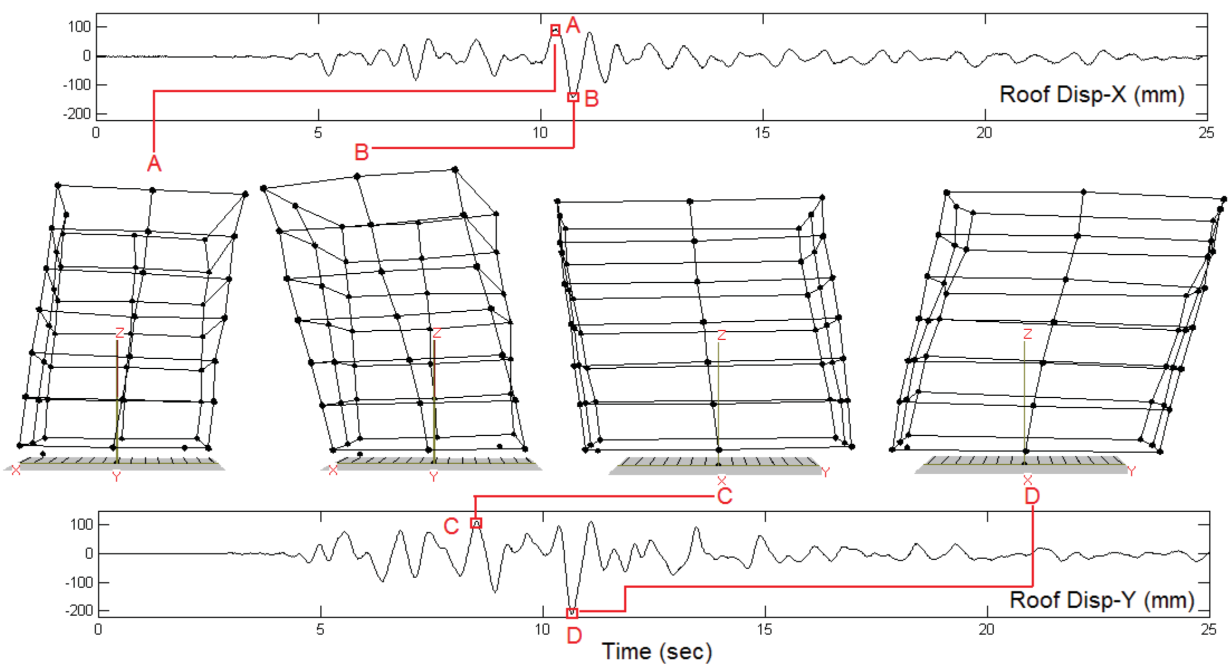

Figure 13. Time captures of the system deformation relative to the shake table during four points in time for the LED optical tracking system

Inter-story drift is often used in displacement based procedures to evaluate the performance of a wood frame building. The resulting inter-story drift of the Capstone building was calculated by subtracting the absolute displacement measurement between stories and dividing the value by the story height. The maximum values for the average inter-story drift are presented in Table 3. The average was computed by averaging the drift measured from seven different LED optical tracking markers at each story level.

Table 3. Averaged peak inter-story drift measured during the three tests

Peak Inter-story Drift (%)	Seismic Test 1		Seismic Test 2		Seismic Test 3	
	X	Y	X	Y	X	Y
St1	0.26	0.44	0.49	0.77	0.84	1.12
St2	0.35	0.42	0.63	1.05	0.97	1.46
St3	0.29	0.54	0.64	1.02	0.89	1.64
St4	0.30	0.44	0.77	1.22	1.10	1.48
St5	0.36	0.46	0.64	1.14	1.00	1.88
St6	0.40	0.21	0.88	0.58	1.35	1.11

From the above table one can see that the height-wise distribution of inter-story drifts for the building under all three seismic test is close to uniform among the stories, which indicates the absence of a soft story mechanism. Recall this soft story mechanism was observed in wood frame buildings during large earthquakes (such as the 1994 Northridge and the 1995 Kobe earthquakes). The approach used to design the Capstone test specimen which is outlined in Pang et al (2009) vertically distributes the shears according to the deformed state of the structure essentially eliminating or at least drastically reducing the probability of a soft story being present. Figure 14 presents the response time histories in the X and Y direction at all three seismic intensity levels for the first story as well as for the story that had the largest transient drift. The maximum drifts were observed in the upper stories instead of the bottom story, which was, in fact, consistent with numerical model predictions performed prior to testing. The drifts for the top two stories and the associated shear walls in those stories had performance consistent with the other stories even though many of the shear walls stacks did not extend beyond the first five stories.

Another major concern for multi-story buildings is the safety issues related to the high lateral accelerations in the upper stories that may result in occupant injury or casualties due to heavy objects, e.g. furniture. The average acceleration that will be experienced by the occupants during the test was calculated by spatially averaging the acceleration measured by the five sensors installed at each floor level. It turned out the maximum lateral acceleration for the DBE level earthquake on the top story was approximately 1.3 g. The maximum acceleration for the MCE earthquake on the top floor was approximately 1.6 g. With the floor acceleration time history obtained and the seismic mass of each story known, the time history of the base shear force can be retrieved based on principles of basic dynamics. The global hysteresis loops for the building are presented in Figure 15. Similar behavior from one seismic intensity level to the next is observed since the same ground motion (Northridge-Canoga Park) was scaled for each test. As the ultimate base shear capacity of the building, which was used in the performance-based seismic design, is about 2500 kN (562 kips), for the Y direction at intensity level 3 one can see that the test specimen resisted 1824 kN (410 kips) which is approximately 73% of the design shear.

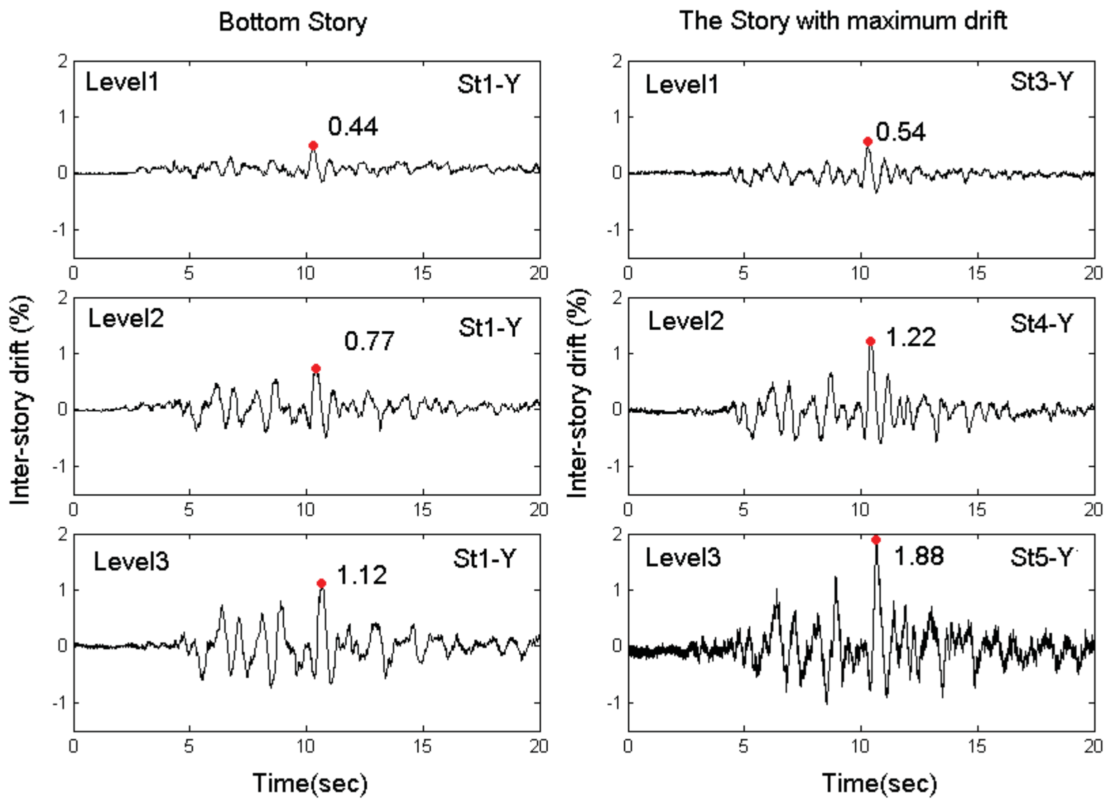

Figure 14. Time history plots for the average inter-story drifts

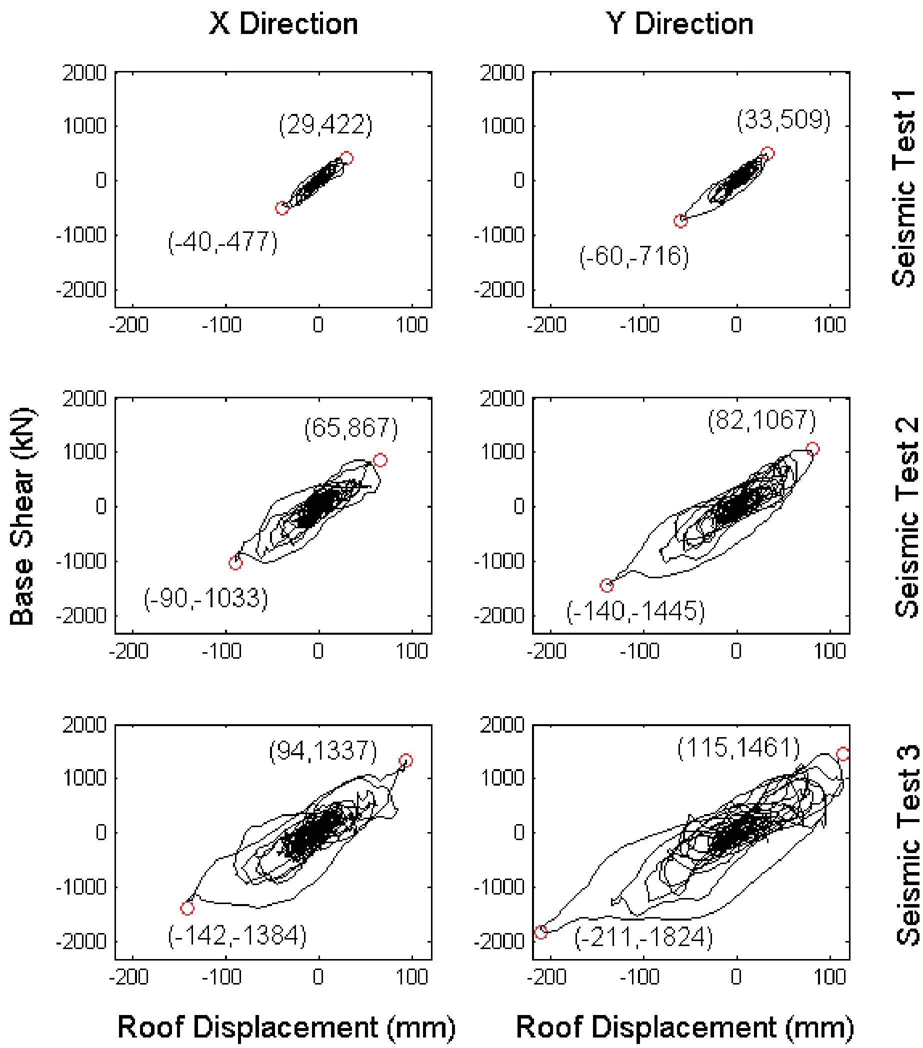

Figure 15. Global hysteresis for all seismic test levels

Recall from the earlier discussion on instrumentation that the anchor tie-down rods were instrumented for approximately half the building at story 1. Figure 16 shows the distribution of maximum forces for the rods throughout the floor during the level 3 seismic tests. The spatial distribution of the peak rod forces was similar for other test levels while the value of the force decreased. Interestingly, one key observation from the rod data is that the maximum hold-down forces do not necessarily occur at the same time. It is not uncommon for the rods at two ends of a wall to act in unison rather than alternating in tension, especially for the walls on the exterior of the test specimen. The alternation in rod tension was observed to shift from the shear wall level to the system level, i.e. where all the rods on one side of the building go into tension while the rods on the other side are not in tension. It is quite clear that the rods from different walls act as a single system to resist the overturning moment generated at the base of this six-story building.

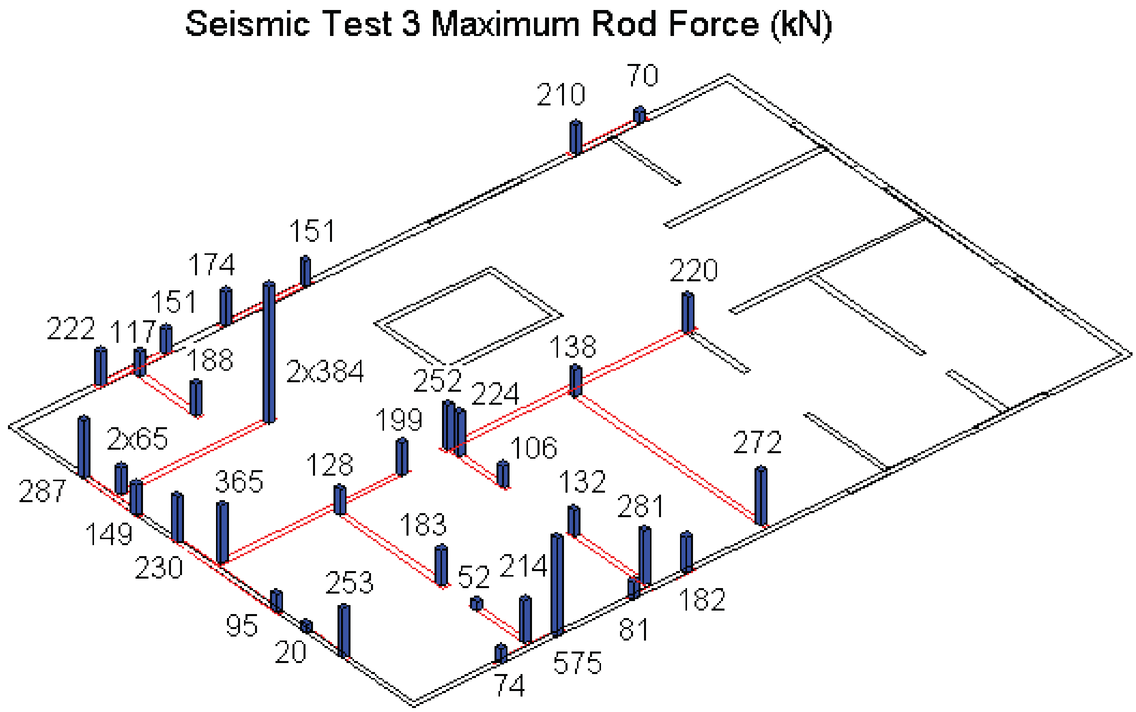

Figure 16. Maximum steel rod tension during level 3 test

As mentioned earlier, the damage to the test specimen from the three seismic tests was not felt to be significant even for the 2500 year (MCE level) earthquake. There was no visible damage to any structural components or assemblies of the building, with damage limited to the gypsum wall board (GWB). The GWB damage was observed primarily around the corners of openings as illustrated by the post-shake photographs in Figure 17. The damage and its correlation to inter-story drifts will be presented in its entirety in a forthcoming paper by several of the authors and can be found detailed in the forthcoming NEESWood project report by Pei et al. (2009).

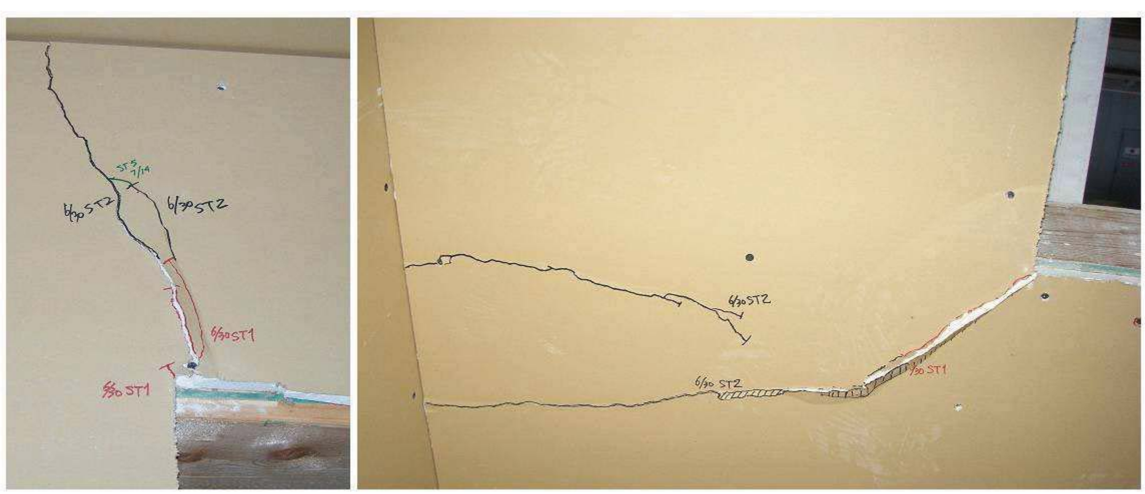

Figure 17. Typical damage observation around wall openings

4. Conclusions

A series of three shake table tests on a full-scale six-story light-frame wood building was completed in July 2009 in Miki, Japan. It is critical to perform tests such as these at full scale and with full size structures to ensure that size effects and scaling issues do not arise and taint the conclusions. The NEESWood Capstone building, designed with the performance based design procedure developed within the NEESWood project, the building was able to achieve very good performance under both DBE and MCE level earthquakes, with maximum averaged inter-story drifts on the order of 2% to 3%. The damage to the structural and non-structural components of the building was very minor, all repairable. Peak shear wall drifts at one corner slightly exceeded 3% for the MCE level test. Damage was limited to non-structural damage; specifically cracking of the gypsum wall board near opening such as doors and windows. All damage observed during testing would be easily reparable and not affect future performance during earthquakes. The Capstone building performed very well and did not experience a soft story mechanism at any of the test levels; this is the result of applying the direct displacement design procedure which distributes the shear height-wise throughout the structure based on softened lateral stiffness. The averaged floor accelerations were felt to be reasonable at the higher story levels, although objects would still need to be anchored as recommended by FEMA. Even with the approximately symmetric floor plan and evenly distributed seismic mass, considerable torsional response was still observed during the seismic tests. Inclusion of torsion is needed within PBSD for mid-rise light-frame wood buildings. The hold down system employed in the design of the specimen serves the critical role of transferring uplift forces down to the foundation and thereby preventing overturning. Although installed for each shear wall, the hold down rods acted as a system to provide overturning restraint to the entire floor plan, and only at times did they act as a semi-isolated shear wall stack. In light of this observation, development of a system level design procedure for hold down rods used in multi-story woodframe construction is recommended. As anticipated, the majority of lateral displacements were not due to shear deformation of the wood shear walls, but from cumulative elongation of the hold down rods, a small amount of uplift, and a global bending of wall systems.

In conclusion, it can be stated that six-story light-frame wood construction in high seismic regions can perform very well in a major earthquake provided they are designed appropriately. The test results summarized herein validate the performance-based seismic design philosophy developed within the NEESWood project, to the extent one specimen can provide a validation. New procedures, such as performance-based seismic design, are the way to ensure good performance for taller wood frame buildings during earthquakes.

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FPInnovations – Forintek Division
Western Region
2665 East Mall
Vancouver, British Columbia V6T 1W5

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Seismic Performance of 6-Storey Wood-Frame Buildings

Final Report

by

Chun Ni and Marjan Popovski

Prepared for
Building and Safety Policy Branch
Office of Housing and Construction Standards
Ministry of Housing and Social Development
PO Box 9844 Stn Prov Govt
Victoria, BC V8W 9T2

June 2009

Project No. 6482

Chun Ni	Bill Deacon	Erol Karacabeyli
Project Leader	Reviewer	for Department Manager

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Summary

In this report, the seismic performance of 6-storey wood frame residential buildings is studied. Two building configurations, a typical wood-frame residential building and a building to be tested under the NEESWood project, were studied. For each building configuration, a four-storey building and a six-storey building were designed to the current (pre-April 6, 2009) 2006 BC Building Code (BCBC) and to the anticipated new requirements in the 2010 National Building Code of Canada (NBCC), resulting in four buildings with different designs. The four-storey building designed to the current 2006 BC Building Code served as the benchmark building representing the performance of current permissible structures with common architectural layouts.

In the design of both four-storey and six-storey buildings, it was assumed that the buildings are located in Vancouver on a site with soil class C. Instead of using the code formula, the fundamental natural period of the buildings was determined based on the actual mass and stiffness of wood-based shearwalls. The base shear and inter-storey drift are determined in accordance with Clauses 4.1.8.11.(3)(d)(iii) and 4.1.8.11.(3)(d)(iv) of BCBC, respectively.

Computer programs DRAIN 3-D and SAPWood were used to evaluate the seismic performance of the buildings. A series of 20 different earthquake records, 14 of the crustal type and 6 of the subcrustal type, were provided by the Earthquake Engineering Research Facility of the University of British Columbia and used in the evaluation. The records were chosen to fit the 2005 NBCC mean PSA and PSV spectra for the city of Vancouver.

For representative buildings designed in accordance with 2006 BCBC, seismic performance with and without gypsum wall board (GWB) is studied. For representative buildings designed in accordance with the 2010 NBCC, the seismic performance with GWB is studied. For the NEESWood building redesigned in accordance with 2010 NBCC, seismic performance without GWB is studied. Ignoring the contribution of GWB would result in a conservative estimate of the seismic performance of the building.

In the 2006 BCBC and 2010 NBCC, the inter-storey drift limit is set at 2.5 % of the storey height for the very rare earthquake event (1 in 2475 year return period). Limiting inter-storey drift is a key parameter for meeting the objective of life safety under a seismic event.

For 4-storey and 6-storey representative wood-frame buildings where only wood-based shearwalls are considered, results from both DRAIN-3D and SAPWood show that none of the maximum inter-storey drifts at any storey under any individual earthquake exceed the 2.5% inter-storey drift limit given in the building code. With DRAIN-3D, the average maximum inter-storey drifts are approximately 1.2% and 1.5% for 4-storey and 6-storey buildings designed with 2006 BCBC, respectively.

For the NEESWood wood-frame building, none of the maximum inter-storey drifts at any storey under any individual earthquake exceed the 2.5% inter-storey drift limit for 4-storey building obtained from SAPWood and 6-storey building obtained from DRAIN-3D and SAPWood. For any 4-storey building analysed with DRAIN-3D, approximately half of the earthquakes resulted in the maximum inter-storey drifts greater than 2.5% inter-storey limit. This is partly due to the assumptions used in Drain-3D model in which the lumped mass at each storey is equally distributed to all the nodes of the floor. As a result, the total weight to counteract the uplift force at the ends of a wall would be much smaller than that anticipated in the design, thus causing hold-downs to yield and large uplift deformations to occur.

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Based on the analyses of a representative building and a redesigned NEESWood building situated in the city of Vancouver that subjected the structures to 20 earthquake records, 6-storey wood-frame building is expected to show similar or smaller inter-storey drift than a 4-storey wood-frame building, which is currently deemed acceptable under the current building code.

Acknowledgements

The financial support by the Building and Safety Policy Branch (BSPB) of the Office of Housing and Construction Standards (OHCS) for this project is gratefully acknowledged. We are grateful to the Earthquake Engineering Research Facility of the University of British Columbia for providing the earthquake records suited for the city of Vancouver used in this study.

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1 Objectives

The main objective of the work contained in this report is to evaluate the seismic performance of six-storey wood-frame buildings designed according to the proposed changes in the BC Building Code and the capacity-based design philosophy implemented in the upcoming Canadian Standard for Engineering Design in Wood (CSA O86.1 2009), as well as the next edition of the National Building Code of Canada (2010 NBCC).

2 Introduction

Mid-rise multi-family buildings are within reach of the current technology in wood-frame construction and offer a way to diversify the markets for Canadian wood products. Recently, the Government of BC has expressed interest in the concept of mid-rise wood-frame buildings as a response to the shift towards sustainable densification of urban and suburban centers and to the need for affordable housing. As a result, the Ministry of Housing and Social Development is pursuing regulatory changes to increase the limit on wood-frame construction to six storeys in the BC Building Code.

To prepare for such code revisions, the Building and Safety Policy Branch (BSPB) of the Office of Housing and Construction Standards (OHCS) has engaged consultants to draw up the required changes to the BC Building Code and to identify technical and process risks related to six-storey wood-frame construction. Technical advisory groups comprising a wide range of building sector stakeholders were formed to help identify potential relevant issues related to six-storey wood buildings and to help develop appropriate mitigation and implementation strategies. Based on the reported specific issues and the initial feedback from the technical advisory groups, potential technical impediments and implementation issues related to introduction of six-storey wood-frame buildings in BC were identified. These include fire safety, structural safety (in particular the seismic performance), wood shrinkage, and building envelope integrity. FPInnovations staff has been involved in these technical advisory groups and continue to participate in the stakeholders meetings.

As the demand for higher density housing in BC tends to be in areas with high seismic risk, one of the paramount concerns to designers of six-storey wood-frame construction is the seismic performance of such buildings. To address these concerns, FPInnovations' staff under contract with BSPB carried out a study to assess the performance of six-storey wood-frame buildings in earthquake prone areas. The results of this study presented in this report will not only provide the technical support for the proposed code change, but will also help increase the confidence of the designers and stakeholders in the seismic performance of mid-rise wood-frame construction.

3 Scope

The scope of the work consists of a series of non-linear dynamic analyses of selected buildings. Two building configurations, a typical wood-frame residential building and a test building under the NEESWood project (the Capstone Tests), were studied. For each building configuration, a four-storey building and a six-storey building were designed by a consultant to the current (pre-April 6, 2009) 2006 BC Building Code and to anticipated new requirements in the 2010 National Building Code of Canada, resulting in four buildings of different designs. The four-storey building designed to the current 2006 BC

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Building Code served as the benchmark to represent performance of current permissible structures for common architectural layouts. The work to be performed in this study is provided in Table 1.

Table 1 Scope of work to be performed

No. of Storeys	A representative WFC building, designed with 2006 BCBC	A representative WFC building, designed with 2010 NBCC and O86.1-2009	NEESWood test building, designed with 2010 NBCC and O86.1-2009
4	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU
6	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU	▪ Design by RJC ▪ Assess by Forintek ▪ Check by CSU

RJC - Read Jones Christoffersen Ltd.
CSU - Colorado State University

The NEESWood Capstone project is a multi-year US research project to develop methods to assess the seismic resistance of mid-rise wood frame construction. Under this program, a series of shake table tests on a six-storey wood-frame structure will be carried out in Japan during the summer of 2009. FPInnovations is one of the several technical contributors to this project and has assisted in the coordination of the use of BC lumber and other wood products in the test building under the financial support of Forest Innovation Investment of BC. The work presented in this report utilises the knowledge, expertise, test data, and numerical tools developed under the NEESWood Capstone project for assessing the seismic behaviour of wood-frame buildings and applies them for assessment of 6-storey wood-frame construction (WFC) buildings in BC.

4 Project Team

- Dr. Chun Ni, P.Eng., project leader, FPInnovations – Forintek Division
- Mr. Grant Newfield, P.Eng, Read Jones Christoffersen Ltd. (RJC)
- Dr. John van de Lindt, P.E., Colorado State University (CSU)
- Mr. Maurizio Follesa, Timber Engineering, Italy
- Dr. Marjan Popovski, P.Eng., FPInnovations – Forintek Division
- Mr. Erol Karacabeyli, P.Eng., FPInnovations – Forintek Division

5 Seismic Design of the Studied Buildings

5.1 A representative wood-frame construction (WFC) residential building

A 4-storey building built as a part of revitalized Vancouver neighbourhood was used as a representative WFC building in this study (Figure 1). In the original design, sections 2 and 3 of the building (Figure 1) were assumed to be separate units and were analyzed separately. Each section was designed with enough strength to carry the seismic loads associated with its own area.

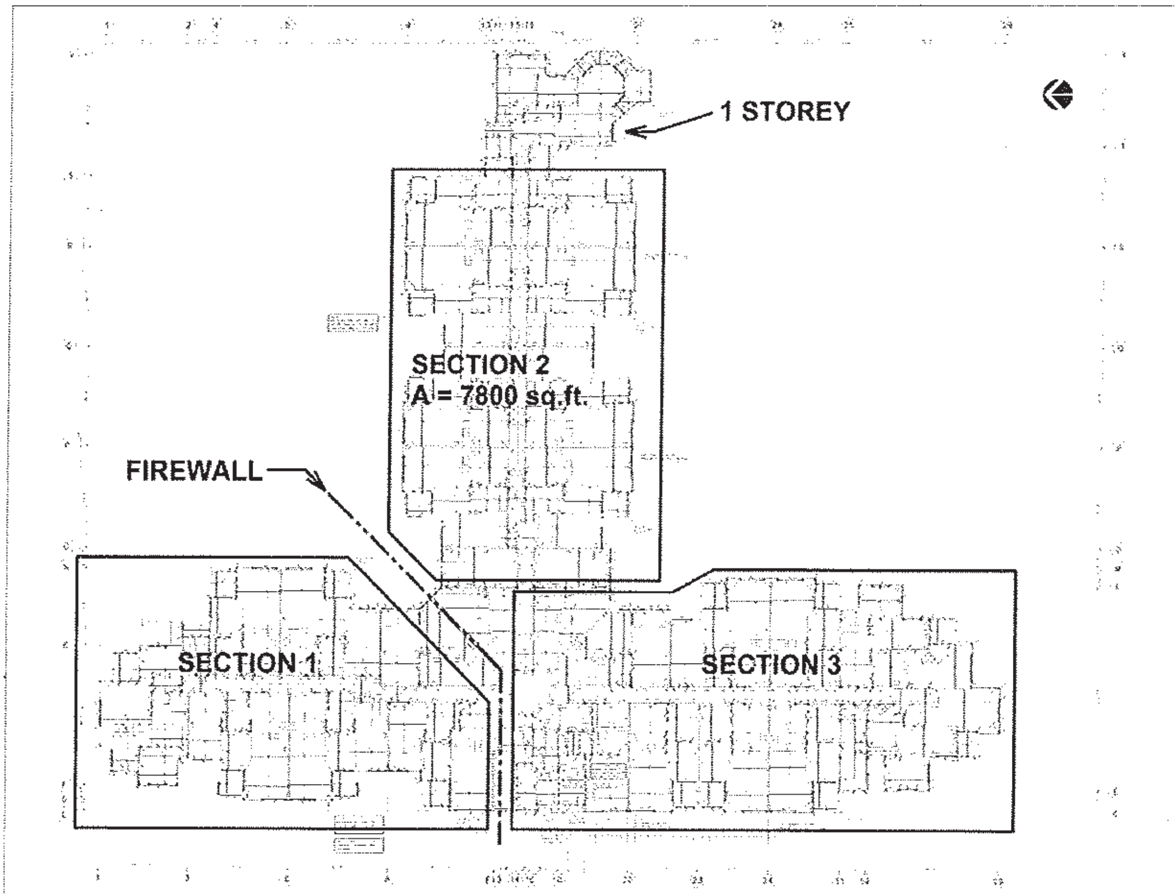

Figure 1 Plan view of the representative building

In discussion with RJC, it was decided that only section 2 of this building would be used in this study. Although buildings could be simpler or more complex in practice, it was believed that the section 2 of the building is a reasonable portion of it, and can be seen as being a good representation of the current construction practice. Section 2 of the building includes a double loaded corridor where all the corridor and party walls are used as shearwalls.

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In the design, it was assumed that the buildings are located in Vancouver on a site with soil class C according to NBCC. Instead of using the NBCC formula, the fundamental natural period was determined based on actual mass and stiffness of wood-based shearwalls. This period was then used to determine the minimum equivalent static earthquake force applied on the building. The building loads at the roof and at each floor of the building are provided in Table 2. The building periods and seismic forces, V, are provided in Table 3. Details of the shearwalls for the 4 and 6-storey buildings designed in accordance with 2006 BCBC (before April 6, 2009 amendments which now require cut-offs on seismic forces) and 2010 NBCC are provided in Tables 4 and 5. Seismic forces in each direction were distributed to walls based on the highest value of either the walls proportion of tributary area, the walls length divided by total length of walls, or a comparison of the relative wall stiffnesses. The potential effects of torsion were not considered in the design. It should be noted that engineering judgement was used in the distribution of forces to the various walls and that the design although representative, does not result in a minimum code design. The design drawings of the 4 and 6-storey buildings are provided in Appendix A.

Table 2 Building loads used in the seismic design of the 4 and 6-storey buildings

	Uniformly distributed load (kPa)	Area (m^2)	Total load (kN)
Roof (dead load + 25% snow load)	1.20	919.74	1103.7
Floor (dead load)	1.92	789.68	1516.2

Table 3 Building periods and seismic loads used in the design of the 4 and 6-storey buildings

4 Storey Building (W = 5660 kN)			
Building Period calculation	T (s)	V (%W)	V (kN)
Ta (code calculated period)	.34	.123W	696
2 x Ta (current cut off for strength)[1]	.68	.104W	589
T (based on engineering mechanics)[2]	1.1	.062W	350
6 Storey Building (W = 8700 kN)			
Building Period calculation	T (s)	V (%W)	V (kN)
Ta (code calculated period)	.445	.123	1070
2 x Ta (current cut off for strength)[1]	.889	.078[3]	679[3]
T (based on engineering mechanics)[2]	1.67	.048	418

Notes : 1 – used for strength design based on NBBC clause 4.1.8.11.(3)(d)(iii)
2 – used for deflection calculations based on NBBC clause 4.1.8.11.(3)(d)(iv)
3 – increased loads 10% for strength design (Used V = 748 kN)

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Table 4 Shearwall and hold-down details of the Wood-frame building designed in accordance with 2006 BCBC

		6-storey building				4-storey building			
		SW 1	SW 2	SW 3	SW 4	SW 1	SW 2	SW 3	SW 4
6th storey	Hold-down	SR9	SR5	SR5	SR5				
	End stud	6-2x4	4-2x4	4-2x4	4-2x4				
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm				
	Nail	8d	8d	8d	8d				
	Nail spacing	150 mm	150 mm	150 mm	150 mm				
5th storey	Hold-down	SR9	SR5	SR5	SR5				
	End stud	6-2x4	4-2x4	4-2x4	4-2x4				
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm				
	Nail	8d	8d	8d	8d				
	Nail spacing	150 mm	150 mm	150 mm	150 mm				
4th storey	Hold-down	SR9	SR5	SR5	SR5	SR5	SR5	SR5	SR5
	End stud	6-2x4	6-2x4	6-2x4	6-2x4	4-2x4	4-2x4	4-2x4	4-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	8d	8d	8d	8d	8d	8d	8d
	Nail spacing	100 mm	75 mm	100 mm	100 mm	150 mm	150 mm	150 mm	150 mm
3rd storey	Hold-down	SR10	SR7	SR7	SR7	SR7	SR5	SR5	SR5
	End stud	8-2x4	8-2x4	6-2x4	8-2x4	4-2x4	4-2x4	4-2x4	4-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	100 mm	75 mm	100 mm	75 mm	150 mm	100 mm	150 mm	150 mm
2nd storey	Hold-down	SR10	SR9	SR7	SR9	SR9	SR7	SR5	SR5
	End stud	8-2x4	8-2x4	8-2x4	8-2x4	6-2x4	6-2x4	6-2x4	6-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	75 mm	75 mm	75 mm	65 mm	100 mm	75 mm	100 mm	100 mm
1st storey	Hold-down	SR10	SR9	SR9	SR9	SR9	SR7	SR7	SR7
	End stud	8-2x4	8-2x6	8-2x4	8-2x6	6-2x4	6-2x4	6-2x4	6-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	12.7 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	75 mm	65 mm	75 mm	65 mm	100 mm	75 mm	100 mm	100 mm

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Table 5 Shearwall and hold-down details of the wood-frame building designed in accordance with 2010 NBCC

		6-storey building				4-storey building			
		SW 1	SW 2	SW 3	SW 4	SW 1	SW 2	SW 3	SW 4
6th storey	Hold-down	SR9	SR5	SR5	SR5				
	End stud	6-2x4	4-2x4	4-2x4	4-2x4				
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm				
	Nail	8d	8d	8d	8d				
	Nail spacing	150 mm	150 mm	150 mm	150 mm				
5th storey	Hold-down	SR9	SR5	SR5	SR5				
	End stud	6-2x4	4-2x4	4-2x4	4-2x4				
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm				
	Nail	8d	8d	8d	8d				
	Nail spacing	150 mm	150 mm	150 mm	150 mm				
4th storey	Hold-down	SR9	SR7 [1]	SR5	SR7 [1]	SR5	SR5	SR5	SR5
	End stud	6-2x4	6-2x4	6-2x4	6-2x4	4-2x4	4-2x4	4-2x4	4-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	8d	8d	8d	8d	8d	8d	8d
	Nail spacing	100 mm	75 mm	100 mm	100 mm	150 mm	150 mm	150 mm	150 mm
3rd storey	Hold-down	SR10	SR7	SR7	SR7	SR7	SR5	SR5	SR5
	End stud	8-2x4	8-2x4	6-2x4	8-2x4	4-2x4	4-2x4	4-2x4	4-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	100 mm	75 mm	100 mm	75 mm	150 mm	100 mm	150 mm	150 mm
2nd storey	Hold-down	SR10	SR9	SR7	SR9	SR9	SR7	SR7 [1]	SR7 [1]
	End stud	8-2x4	8-2x4	8-2x4	8-2x4	6-2x4	6-2x4	6-2x4	6-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	9.5 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	75 mm	75 mm	75 mm	65 mm	100 mm	75 mm	100 mm	100 mm
1st storey	Hold-down	SR10	HSR9 [1]	SR9	HSR9 [1]	SR9	SR7	SR7	SR7
	End stud	8-2x4	8-2x6	8-2x4	8-2x6	6-2x4	6-2x4	6-2x4	6-2x4
	sheathing	12.7 mm	12.7 mm	12.7 mm	12.7 mm	9.5 mm	12.7 mm	9.5 mm	9.5 mm
	Nail	8d	10d	8d	8d	8d	8d	8d	8d
	Nail spacing	75 mm	65 mm	75 mm	65 mm	100 mm	75 mm	100 mm	100 mm

Note [1] – indicates difference between 2006 BCBC and 2010 NBCC.

Design calculations have been included in Appendix B for wall 4 (as shown in Figure 15) which is a 9.75m long 6 storey wall. Table 6 indicates the forces used for strength design, forces used for deflection calculations, the calculated deflection, and inter-storey drifts for wall 4.

Table 6 Design forces and Deflections for a 9.75m long 6 storey representative Wall

Forces, Drifts, and Deflections for a 9.75m long 6 Storey Wall				
Level	V (strength design)	V (deflections)	Deflection (mm)	Drift (%)
Roof	22.4 kN	12.3 kN	218	1.1
6	23.3 kN	12.8 kN	167	1.3
5	18.7 kN	10.3 kN	131	1.2
4	14.0 kN	7.7 kN	97	1.3
3	9.3 kN	5.1 kN	59	1.1
2	4.7 kN	2.6 kN	29	1.0

5.2 NEESWood Capstone test building

The NEESWood Capstone project is a research project led by a consortium of US universities that specialize in earthquake engineering research with aim to develop methods to assess the seismic performance of mid-rise wood frame construction. Under this project, a key activity is the shake table test of a six-storey wood-frame structure which was designed for a locality with high seismic loads in the state of California. Japanese research facilities that can simulate and apply the actual ground motion of a severe earthquake will be used to test the full-scale six-storey structure. The shake table tests will be conducted in July 2009. Results of the shake table tests can be used to check the accuracy of programs used in this study. A plan view of the building is shown in Figure 2.

In this study, the full-scale six-storey test building was redesigned in accordance with 2010 NBCC. Similar to the representative WFC residential building, it was assumed that the buildings are located in Vancouver on a site with soil class C. The fundamental lateral period was determined based on actual mass and stiffness of wood-based shearwalls and the period was then used to determine the minimum equivalent static earthquake force applied to the building. Due to the building configuration, the interior shear walls in the E-W direction are discontinuous at the 6th floor. In this design, each shear wall was designed with the greater of lateral loads based on either a flexible or rigid floor assumption. Torsional loads were considered for the rigid floor analysis. Although the cut off of walls at the 6th floor is not permitted under the 2006 BCBC (with amendments after April 6, 2009), capacity design principles were used to transfer the forces of the 1 storey shearwall at level 6 to other walls below. This gave rise to additional complexities in the design..

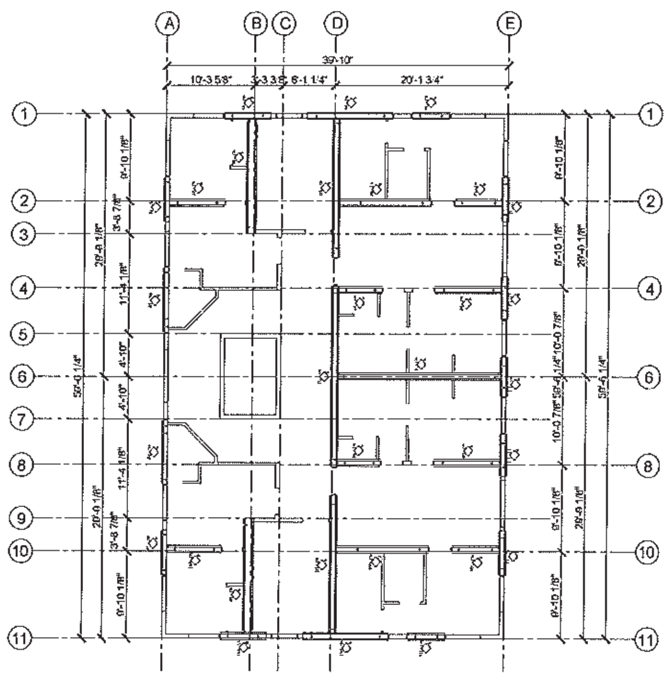

Figure 2 Plan view of the NEESWood Capstone test building

The building loads at the roof and at each floor of the building are provided in Table 7. The building periods and seismic forces are provided in Table 8. Details of the shearwalls in 4 and 6-storey buildings designed in accordance with 2006 BCBC (before April 6, 2009 amendments which now require cut-offs on seismic forces) and 2010 NBCC are provided in Table 9. The design drawings of the 4 and 6-storey buildings are provided in Appendix A.

Table 7 Building loads used in the seismic design of the 4 and 6-storey NEESWood buildings

	Uniformly distributed load (kPa)	Area (m^2)	Total load (kN)
Roof (dead load + 25% snow load)	0.96	312	300
Floor (dead load)	1.68	224	375

Table 8 Building periods and seismic loads used in the design of the 4 and 6-storey NEESWood buildings

4 Storey Building (W = 1425 kN)			
Building Period calculation	T (s)	V (%W)	V (kN)
Ta (code calculated period)	.302	.123W	175
2 x Ta (current cut off for strength)[1]	.604	.113W	161
T (based on engineering mechanics)[2]	1.1	.062W	88
6 Storey Building (W = 2175 kN)			
Building Period calculation	T (s)	V (%W)	V (kN)
Ta (code calculated period)	.409	.123	267
2 x Ta (current cut off for strength)[1]	.818	.087	189
T (based on engineering mechanics)[2]	1.70	.047	102

Notes : 1 – used for strength design based on NBBC clause 4.1.8.11.(3)(d)(iii)
2 – used for deflection calculations based on NBBC clause 4.1.8.11.(3)(d)(iv)

Table 9 Shearwall and hold-down details of the NEESWood buildings designed in accordance with 2010 NBCC

		6-storey building						4-storey building					
		SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6
6th storey	Hold-down	SR9			SR5	SR5	SR5						
	End stud	6-2x6			6-2x6	6-2x6	2-2x4						
	sheathing	9.5 mm*			9.5 mm	9.5 mm	9.5 mm						
	Nail	8d			8d	8d	8d						
	Nail spacing	150 mm*			150 mm	150 mm	100 mm						
5th storey	Hold-down	SR9	SR5	SR9	SR5	SR5							
	End stud	6-2x6	6-2x6	6-2x6	6-2x6	6-2x6							
	sheathing	9.5 mm*	9.5 mm*	12.7mm*	9.5 mm	9.5 mm							
	Nail	8d	8d	8d	8d	8d							
	Nail spacing	127 mm*	150 mm*	100 mm*	75 mm	75 mm							
4th storey	Hold-down	SR9	SR7	SR9	SR7	SR7		SR5			SR5	SR5	SR5
	End stud	6-2x6	6-2x6	8-2x6	6-2x6	6-2x6		4-2x6			4-2x6	4-2x6	4-2x4
	sheathing	9.5 mm*	9.5 mm*	12.7mm*	12.7 mm	12.7 mm		12.7 mm			12.7 mm	12.7 mm	12.7 mm
	Nail	8d	8d	8d	10d	10d		8d			8d	8d	8d
	Nail spacing	100 mm*	127 mm*	100 mm*	75 mm	75 mm		100 mm			150 mm	150 mm	100 mm
3rd storey	Hold-down	SR9	SR9	SR9	SR9	SR9		SR7	SR9	SR9	SR5	SR5	
	End stud	6-2x6	6-2x6	10-2x6	6-2x6	6-2x6		4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
	sheathing	12.7mm*	9.5 mm*	12.7mm*	12.7 mm	12.7 mm		12.7 mm	12.7 mm	12.7 mm	12.7 mm	12.7 mm	
	Nail	8d	8d	10d	10d	10d		10d	8d	10d	10d	10d	
	Nail spacing	100 mm*	100 mm*	100 mm*	75 mm	75 mm		75 mm	75 mm	75 mm	100 mm	100 mm	
2nd storey	Hold-down	HSR9	SR9	SR9	SR9	SR9		SR9	SR9	SR9	SR7	SR7	
	End stud	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6		4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
	sheathing	12.7mm*	12.7mm*	12.7mm*	12.7 mm	12.7 mm		12.7 mm	12.7 mm	12.7 mm	12.7 mm	12.7 mm	
	Nail	10d	8d	10d	10d	10d		10d	10d	10d	10d	10d	
	Nail spacing	100 mm*	100 mm*	100 mm*	50 mm	50 mm		50 mm	75 mm	50 mm	75 mm	75 mm	
1st storey	Hold-down	HSR9	SR9	HSR9	HSR9	HSR9		HSR9	SR9	SR9	SR7	SR7	
	End stud	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6		6-2x6	6-2x6	6-2x6	4-2x6	4-2x6	
	sheathing	12.7mm*	12.7mm*	12.7mm*	12.7 mm	12.7 mm		12.7 mm	12.7 mm	12.7 mm	12.7 mm	12.7 mm	
	Nail	10d	8d	10d	10d	10d		10d	10d	10d	10d	10d	
	Nail spacing	100 mm*	100 mm*	100 mm*	50 mm	50 mm		50 mm	75 mm	50 mm	75 mm	75 mm	

* Sheathing panels are nailed on both sides of the wall.

Design calculations have been included in Appendix B for a wall 5 (figure 16) for both the 4 and 6 storey building. Table 10 and 11 indicates the forces used for strength design, forces used for deflection calculations, the calculated deflection, and inter-storey drifts for wall 5.

Table 10 Design forces and Deflections for a 6.1m long 4 storey representative Wall

Forces, Drifts, and Deflections for a 6.1m long 6 Storey Wall				
Level	V (strength design)	V (deflections)	Deflection (mm)	Drift (%)
Roof	19.9 kN	12 kN	185	2.0
4	12.4 kN	7.4 kN	129	1.9
3	8.3 kN	5.0 kN	77	1.6
2	4.1 kN	2.5 kN	34	1.2

Table 11 Design forces and Deflections for a 6.1m long 6 storey representative Wall

Forces, Drifts, and Deflections for a 6.1m long 6 Storey Wall				
Level	V (strength design)	V (deflections)	Deflection (mm)	Drift (%)
Roof	18.90 kN	7.0 kN	320	2.6
6	9.92 kN	5 kN	248	2.3
5	7.95 kN	4 kN	183	2.2
4	5.95 kN	3 kN	121	1.9
3	3.97 kN	2 kN	68	1.5
2	1.99 kN	1 kN	27	1.0

6 Earthquakes used in Analyses

A series of 20 earthquake records were provided by the Earthquake Engineering Research Facility of the University of British Columbia and used in the evaluation (Table 12). Earthquake records for two types of earthquakes expected for the city of Vancouver were considered: crustal (shallow) and subcrustal (deep) earthquakes. The first 14 records in Table 4 correspond to crustal earthquakes, while the remaining 6 correspond to subcrustal ones.

Table 12 Earthquake records and their characteristics

Earthquake Record Characteristics						
No.	Epicentre	Date	Magnitude	Record ID	SF [1]	PGA [2] (g)
1	San Fernando	9-Feb-1971	6.6	VAN_I_4	1.26	0.34
2	Friuli, Italy-01	6-May-1976	6.5	VAN_I_12	1.02	0.32
3	Gazli, USSR	17-May-1976	6.8	VAN_I_14	0.72	0.52
4	Tabas, Iran	16-Sep-1978	7.4	VAN_I_16	1.23	0.50
5	Imperial Valley-06	15-Oct-1979	6.5	VAN_I_18	1.25	0.20
6	Irpinia, Italy-01	23-Nov-1980	6.9	VAN_I_24	1.21	0.22
7	Nahanni, Canada	23-Dec-1985	6.8	VAN_I_26	1.22	0.39
8	New Zealand-02	2-Mar-1987	6.6	VAN_I_30	1.45	0.49
9	Loma Prieta	18-Oct-1989	6.9	VAN_I_45	0.92	0.17
10	Landers	28-Jun-1992	7.3	VAN_I_63	0.76	0.21
11	Northridge-01	17-Jan-1994	6.7	VAN_I_76	1.02	0.19
12	Manjil, Iran	20-Jun-1990	7.4	VAN_I_137	1.01	0.52
13	Hector Mine	16-Oct-1999	7.1	VAN_I_139	1.01	0.27
14	E. Honshu, Japan	13-Jun-2008	6.8	VAN_I_158	1.05	0.77
15	Nisqually, WA	28-Feb-2001	6.8	VAN_II_8	1.53	0.25
16	Nisqually, WA	28-Feb-2001	6.8	VAN_II_25	1.69	0.18
17	Nisqually, WA	28-Feb-2001	6.8	VAN_II_27	1.74	0.19
18	Michoacan, Mexico	11-Jan-1997	7.1	VAN_II_48	1.43	0.50
19	S. Honshu, Japan	24-Mar-2001	6.4	VAN_II_53	1.70	0.60
20	S. Honshu, Japan	24-Mar-2001	6.4	VAN_II_70	1.84	0.48

Note: [1] SF = Scaling Factor for Vancouver
[2] PGA = Peak Ground Acceleration (after the scaling)

All records were chosen to satisfy the seismic parameters for a locality such as Vancouver according to the 2005 NBCC. Records were scaled to match the average spectral pseudo-velocity, S_v, of the Uniform Hazard Spectrum (UHS) in the 2005 NBCC within the period range of 0.5 and 1.5 s. This was deemed to be the period range in which the structures will be oscillating during most of their response. The S_v spectra were computed from the velocity spectra for a 5% damping of each record. A scaling factor, SF, given by the ratio of the average spectral pseudo-velocity of NBCC UHS spectrum within the period range and the average Sv of each record in that period range, was obtained for each record. Each record was then scaled using this SF factor for use in analyses. The pseudo velocity and acceleration response spectra for all of these records compared to the Vancouver design spectrum are shown in Figures 3 and 4. Besides satisfying the NBCC requirements for acceleration, the chosen records had a range of frequency characteristics throughout the spectrum.

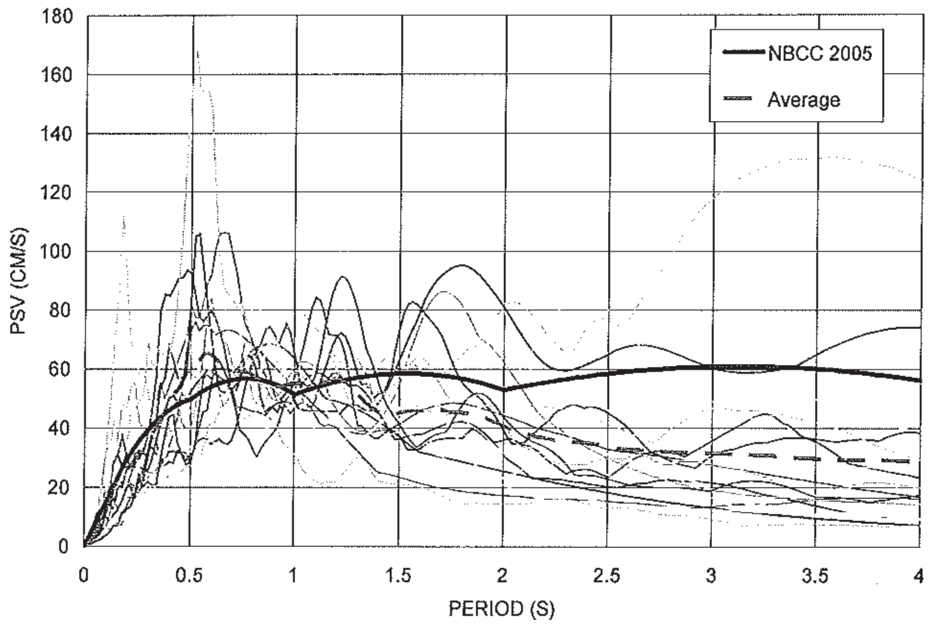

Figure 3 The pseudo velocity response spectra for all records, their average and the 2005NBCC velocity design spectrum for Vancouver

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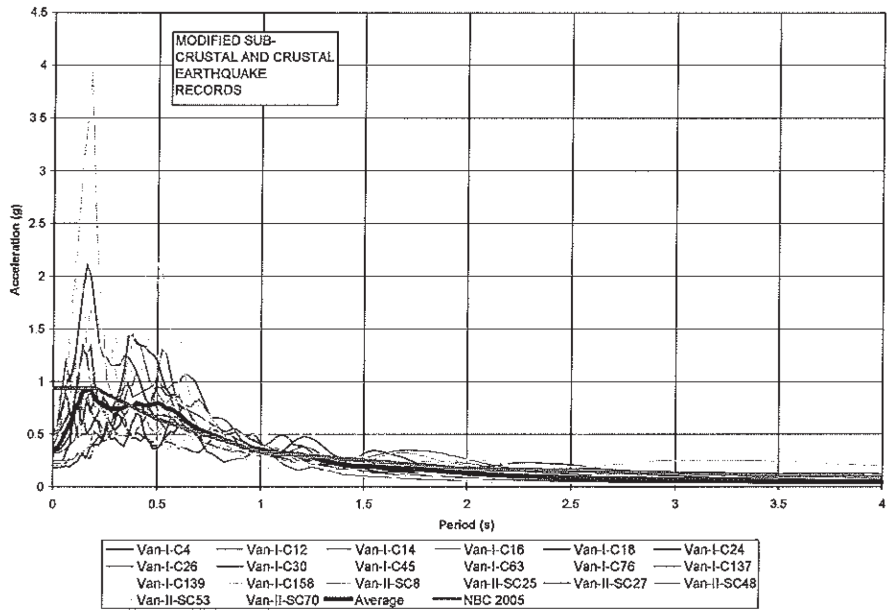

Figure 4 The acceleration response spectra for all records, their average and the 2005 NBCC acceleration design spectrum for Vancouver

7 Seismic Analysis of the Buildings

The seismic analysis of the buildings has been independently carried out by Forintek and Colorado State University (CSU). Computer programs Drain-3D and SAPWood were used by Forintek and CSU, respectively. Both computer programs have been validated with shake table tests of CUREE 2-storey wood-frame buildings and are been used in the prediction of shake table tests of NEESWood 6-storey wood-frame building in Japan during the summer of 2009.

In this section, the following information used in the analysis is provided: a) building modelling, b) shearwall properties, c) hold-down and bearing properties, and d) length and locations of shearwalls. To allow for the comparison of numerical results, the same shearwall properties were used in Forintek and CSU seismic analyses.

7.1 Building Modeling

7.1.1 Drain-3D

Drain-3D is a general structural analysis program. The program contains certain number of inelastic elements to describe the inelastic behaviour of concrete and steel structural elements. A pinching hysteresis model, as shown in Figure 5, was developed at the University of Florence (Ceccotti and Vignoli 1989) and was then implemented in Drain-3D for modelling of wood shearwalls.

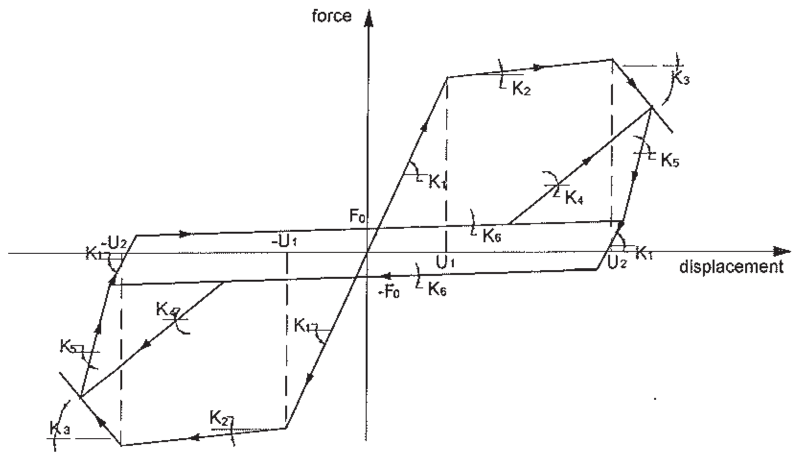

Figure 5 Pinching hysteretic behaviour with six inclinations and constant discharge line used for modeling of the semi-rigid rotational springs

The building was modeled with a 3-D space frame composed of rigid straight members. In the model, each shearwall was considered as a fictitious rectangular frame that consists of four straight rigid elements that is able to deform in shear only. Shear deformation in this frame was represented by four identical rotational springs at each corner of the frame. Parameters of the pinching hysteresis model for the shearwalls were developed by fitting to the force–displacement relationship obtained from reversed cyclic tests of the shearwalls, or from fitting hysteresis loops developed analytically using computer programs that generate such loops based on the nail-slip connection properties.

Figure 6 shows a schematic of the model of the representative 6-storey building in Drain-3D. In the model, each shear wall is connected to the foundation or to the floor below by means of translational springs to represent hold-downs (Figure 7). The translational spring is composed of two parallel elements, one working only in tension with an elastic-perfectly plastic behaviour to represent the properties of the steel rod, and the other working only in compression with elastic behaviour to represent the bearing properties of the top and bottom plates.

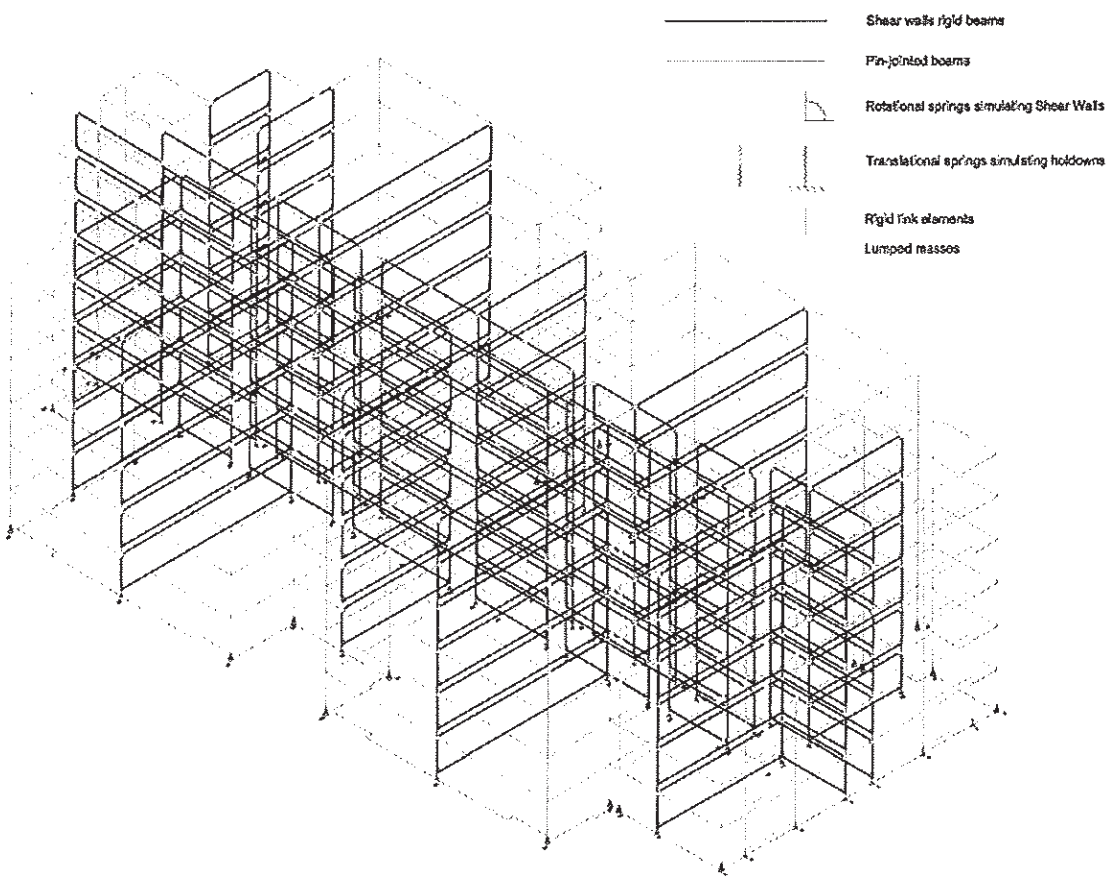

Figure 6 Model of the 6-storey wood-frame building in Drain-3D

At each floor, the top nodes of the shearwalls below that floor and the bottom nodes of shearwalls above that floor have identical (slaved) coordinates. The seismic mass at each storey is equally distributed to all nodes of the floor. Floors were modeled as rigid diaphragms with equivalent cross bracings simulated by rigid pin-jointed linear elements. For the dynamic analyses a 1% stiffness and mass proportional damping ratio was used.

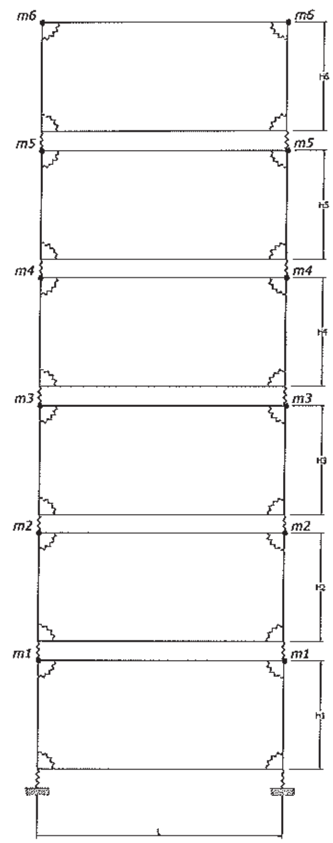

Figure 7 Stacked shearwall assembly model of a 6 storey building with rotational semi-rigid springs and semi rigid axial springs to represent the properties of the hold-downs

7.1.2 SAPWood

The numerical model used in the analyses with SAPWood program was a shear-bending coupled type of nonlinear model specifically designed for analysis of mid-rise wood-frame structures (Pei & van de Lindt, 2008). The model has six degrees of freedom at each storey diaphragm, while each diaphragm is assumed to act as a rigid body in the analyses. The kinematics of the model are illustrated in Figure 8. All lateral or vertical stiffness components (shearwalls, hold-downs, and compression studs.) are represented as nonlinear (or hysteretic) springs connecting point P_i and P_j on the adjacent diaphragms.

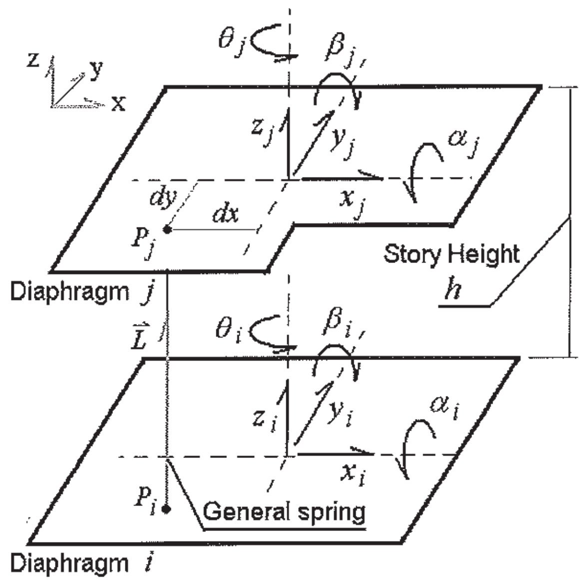

Figure 8 Global degrees of freedom and spring connectivity in the SAPWood model

This formulation allows the model to develop rigid body rotation for the entire storey level without inducing shear deformations. The seismic mass of the building was lumped onto the storey diaphragm, which induces seismic excitation during the ground motion. The dynamic loads cause the diaphragm layers to rotate and translate, while they are held together as a structural system by the nonlinear springs (representing shearwalls, hold-downs, etc.). It should be noted that these nonlinear springs are updated at each time step during the time history integration according to their load-resistance characteristics. This model has been implemented in the analyses of wood-frame buildings and stacked shearwall assemblies and produced good results.

The behaviour of the structures modeled using this method depends largely on the hysteretic spring elements used to represent the shearwall components. While the hysteretic elements for shearwalls can be obtained by cyclic testing of the walls, it is not always possible to have all different walls in the building subjected to a reversed-cyclic test. Instead, cyclic tests on typical nail-sheathing-stud connections can be performed and a computer program can be used to develop shearwall hysteretic responses based on nail connection responses. The model used to generate such hysteresis curves for the shearwalls in this analysis was the Nail-Pattern (NP) module of the SAPWood program. In the SAPWood-NP model, every framing member and sheathing panel is treated as a component of the assembly system. Each component is assumed to be a rigid body which has three in-plane degrees of freedom. The kinematics assumptions for the SAPWood-NP model are illustrated in Figure 9. These components were connected with nails that were modeled with hysteretic spring elements calibrated from existing nail test data.

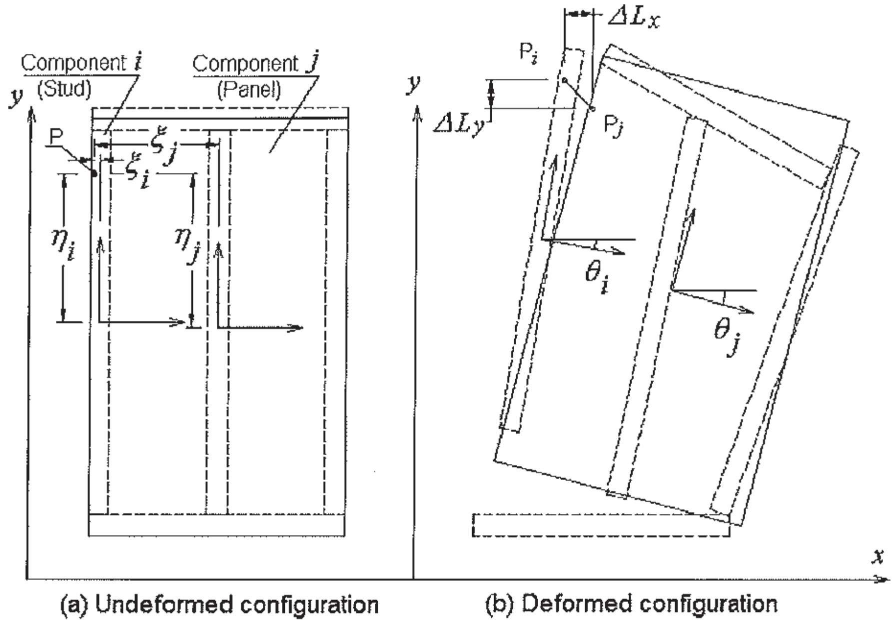

Figure 9 Nail-Pattern (NP) model kinematics

Once the model is established, cyclic displacement protocols can be applied incrementally to the transverse degrees of freedom (DOFs) of the top plate while the bottom plate DOFs are fixed. The displacement of other DOFs are then solved at every displacement step. The resulting force on the top plate undergoing forced deformation is obtained through equilibrium analysis.

An existing 10-parameter hysteretic model used in a number of studies (Folz and Filiatrault, 2004) was used for this analysis. It is a single degree-of-freedom (SDOF) hysteretic model that defines the restoring force response of a wood shearwall under reversed cyclic loading by using exponential backbone curves and linear loading and unloading paths. Ten hysteretic parameters are used to define the loading paths in the CUREE model, which is illustrated in Figure 10. The CUREE model has been shown to be accurate for nail and shearwall behaviour and was felt to be suitable for this analysis.

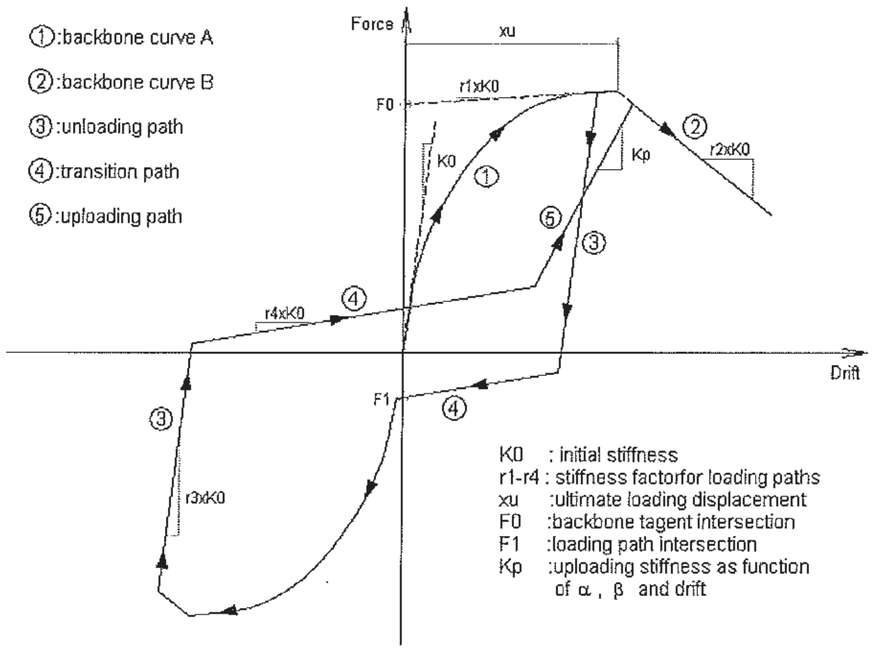

Figure 10 Loading paths and parameters in CUREE model

7.2 Shearwall Properties

7.2.1 Wood-based shearwalls

The hysteresis loops of shearwalls sheathed with plywood were constructed using the SAPWood-NP module. For shearwalls with 8d nails, cyclic tests of nail joints consisting of an 8d nail and 9.5 mm and 12.7 mm plywood panels were used to generate the hysteresis loops of the shearwalls. Since the test results of nail joints consisting of a 10d nail and 9.5 mm and 12.7 mm plywood panels were not available, the hysteresis loops of shearwalls with 10d nails were assumed to be those of shearwalls with 8d nails, with the load scaled up by a factor which is the ratio of the shear capacity of 10d nail joint to the shear capacity of 8d nail joint.

For shearwalls sheathed with gypsum wallboard (GWB), the average hysteresis loops were calibrated from a group of GWB wall tests (Folz and Filiatrault, 2002; Karacabeyli and Ceccotti, 1996; Ceccotti and Karacabeyli 2002).

Figures 11 to 14 show the hysteresis loops of shearwalls sheathed with plywood and gypsum wallboard. For shearwalls sheathed with plywood on one side and GWB on the other side, it is assumed that the hysteresis loops of the shearwalls sheathed with plywood and gypsum wallboard can be superimposed. The numbers in the legend of the Figures 11 to 14 indicate the nail spacing around the perimeter of the panel versus the nail spacing at the intermediate studs in inches.

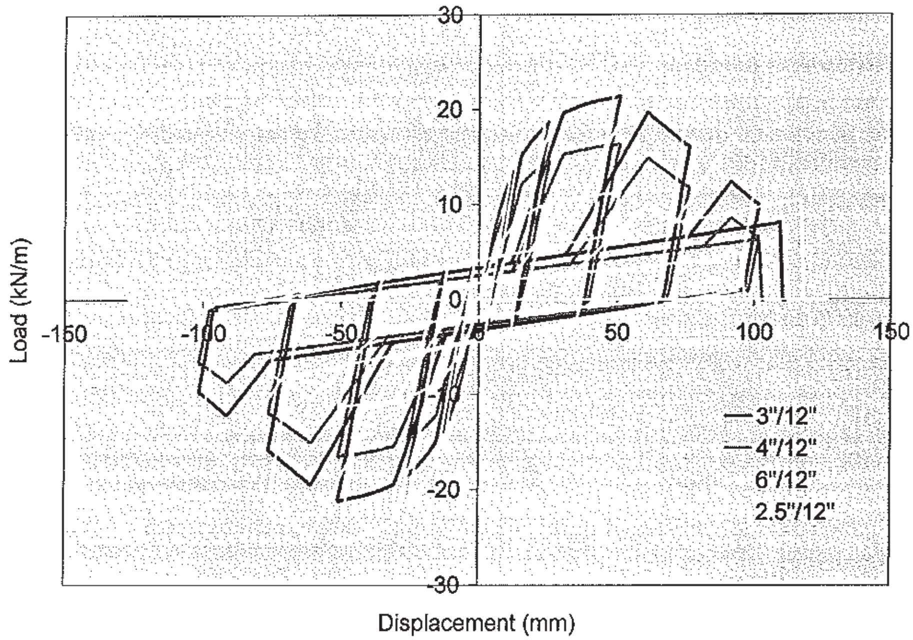

Figure 11 Hysteretic loop for 8d-3/8" ply 4ft x 8ft shearwalls

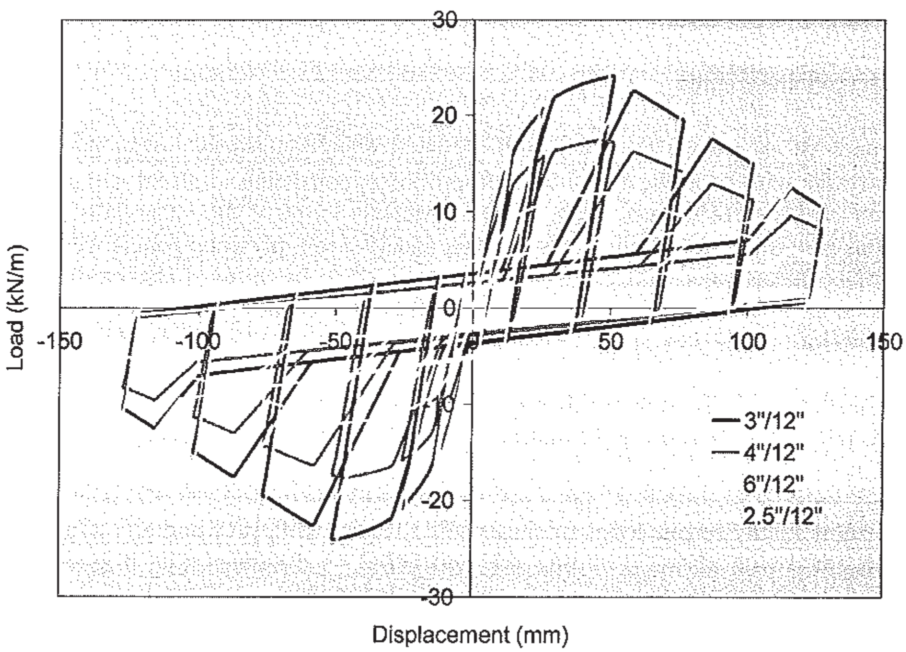

Figure 12 Hysteretic loop for 8d-1/2" ply 4ft x 8ft shearwalls

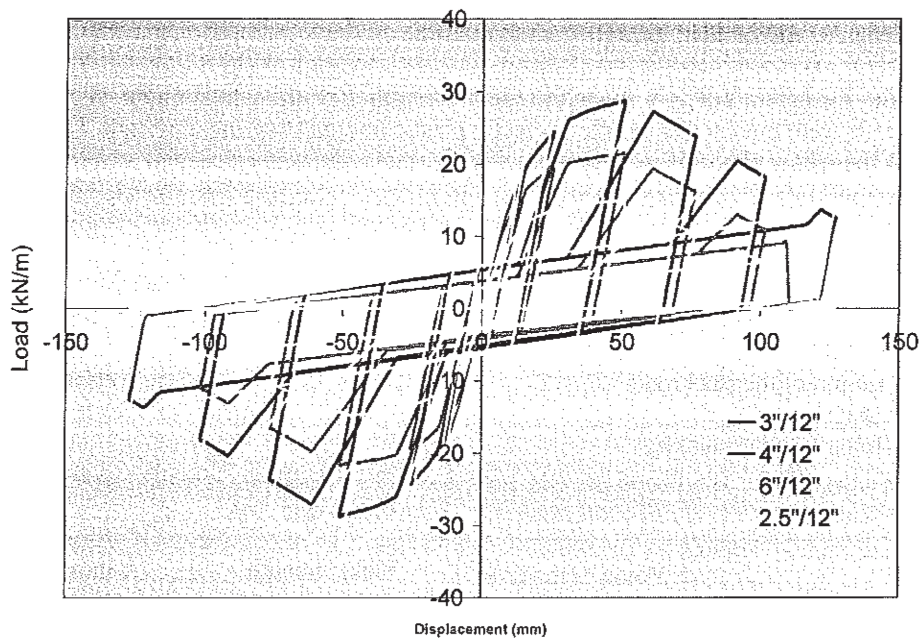

Figure 13 Hysteretic loop for 10d-1/2" ply 4ft x 8ft shearwalls

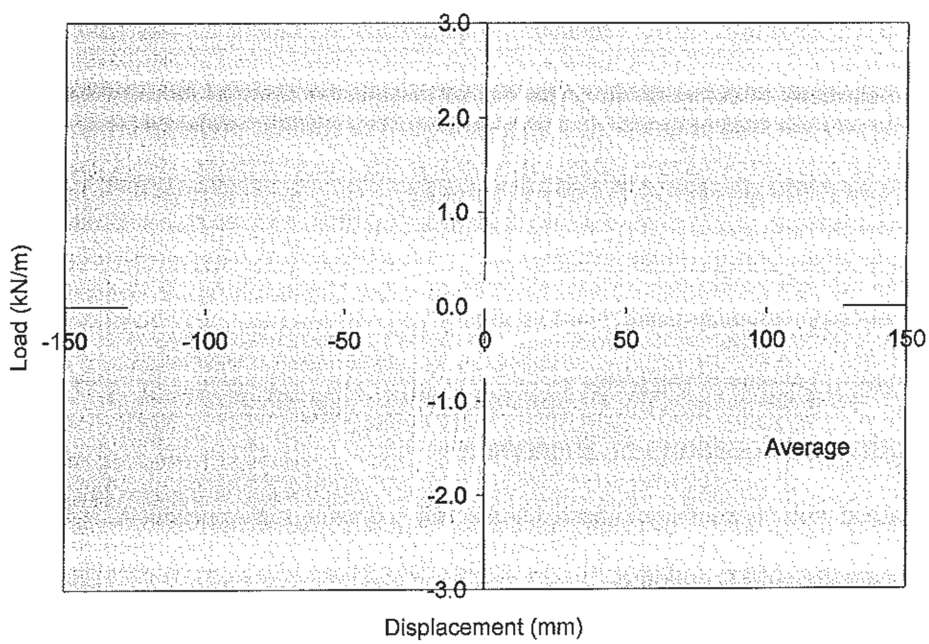

Figure 14 Hysteretic loop for 8ft x 8ft GWB drywall

7.3 Hold-down and Plate Bearing Properties

Table 13 lists the diameter, Young's modulus, yield strength and ultimate strength of Simpson strong rods. The steel rods were modeled as elastic-perfectly plastic nonlinear spring elements. The stiffness and yield strength of the spring elements used to represent the steel rods were calculated as follows:

$K = E * A / l$
$F_y = A * f_y$

Where
E – Young's modulus
A – the cross-section of the steel rod
l – the storey height
f_y – the yield strength of the steel rod

Table 13 Material properties of different models of Simpson strong rods

Model No.	Diameter (mm)	Young's modulus (MPa)	Yield strength		Ultimate strength	
			(kPa)	(kN)	(kPa)	(kN)
SR5	15.9 (5/8 in.)	200000	296500	58.66	413700	81.84
SR7	22.2 (7/8 in.)	200000	296500	114.97	413700	160.41
SR9	28.6 (1-1/8 in.)	200000	296500	190.05	413700	265.17
HSR9	28.6 (1-1/8 in.)	200000	634300	406.57	827400	530.34
SR10	31.7 (1-1/4 in.)	200000	296500	234.63	413700	327.37

The modulus of elasticity of compression perpendicular to grain for Douglas-fir was taken as 490 MPa. The plate bearing was modeled as an elastic spring element. The stiffness of the spring was calculated as follows:

$K = E * A / l,$

Where
E – elasticity of compression perpendicular to grain
A – cross-section of end studs
l – the thickness of bottom and top plates

7.4 Lengths and Locations of Shearwalls

Shearwalls sheathed with plywood are indicated in the design drawings in Appendix A.

7.4.1 Representative WFC building

For the representative WFC buildings designed in accordance with 2006 BCBC and 2010 NBCC, seismic performance of the buildings with GWB is studied. For buildings designed in accordance with 2006

BCBC, seismic performance of buildings without GWB is also studied. Ignoring the contribution of GWB results in a conservative estimate of the seismic performance of the building.

For buildings with GWB, only the GWB contribution in major wall lines was considered. The lateral resistance of doors, windows, and transverse walls was not considered in the model. The major wall lines along which GWB contribution was considered are as follows:

Shearwalls in E-W direction

Axis line T:
10' S.W.1, GWB on one side and plywood on the other side

Axis line S:
23' S.W.3 (on the West side), GWB on one side and plywood on the other side
14' S.W.1 (on the East side), GWB on one side and plywood on the other side

Partition walls between axis lines S and R:
23' drywalls with GWB on both sides of the wall (on the West side),
14' drywalls with GWB on both sides of the wall (on the East side),

Axis line R:
32' S.W.3 (on the West side), GWB on one side and plywood on the other side
32' S.W.3 (on the East side), GWB on one side and plywood on the other side

Two partition walls between axis lines R and Q:
23' drywalls with GWB on both sides of the wall (on the West side),
23' drywalls with GWB on both sides of the wall (on the East side),

Axis line Q:
20' S.W.2 (on the West side), GWB on one side and plywood on the other side
20' S.W.2 (on the East side), GWB on one side and plywood on the other side

Two partition walls between axis lines Q and P:
23' drywalls with GWB on both sides of the wall (on the West side),
23' drywalls with GWB on both sides of the wall (on the East side),

Axis line P:
32' S.W.3 (on the West side), GWB on one side and plywood on the other side
32' S.W.3 (on the East side), GWB on one side and plywood on the other side

Two partition walls between axis lines P and O:
23' drywalls with GWB on both sides of the wall (on the West side),
23' drywalls with GWB on both sides of the wall (on the East side),

Axis line O:
22' S.W.3 (on the West side), GWB on one side and plywood on the other side
22' S.W.3 (on the East side), GWB on one side and plywood on the other side

Shearwalls in N-S direction

Axis line 13:
11' + 12' + 15' + 12' + 17' + 15' + 9' + 16' S.W.4, GWB on one side and plywood on the other side

Axis line 15:
19' + 10' + 15' + 18' + 18' + 15' + 17' S.W.4, GWB on one side and plywood on the other side

Schematic of locations of the shearwalls sheathed with wood-based panels in the representative WFC buildings are shown in Figure 15.

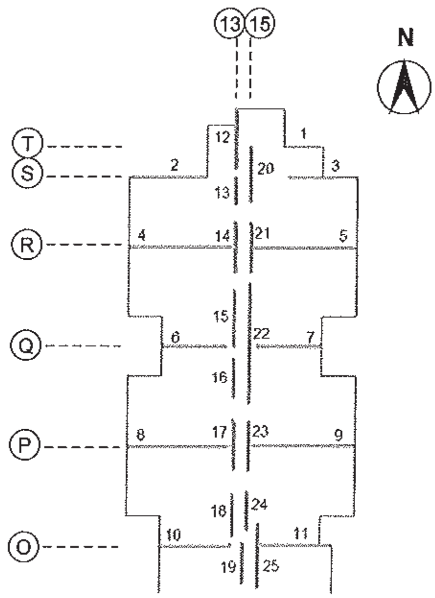

Figure 15 Shearwall identification and locations in representative wood frame building

7.4.2 NEESWood Capstone test building

For the NEESWood Capstone test building designed in accordance with 2010 NBCC, seismic performance of the buildings without GWB is studied. As the lateral load capacities of GWB are not considered, it results in a conservative estimate of the seismic performance of the building. Schematic of locations of the shearwalls sheathed with wood-based panels are shown in Figure 16.

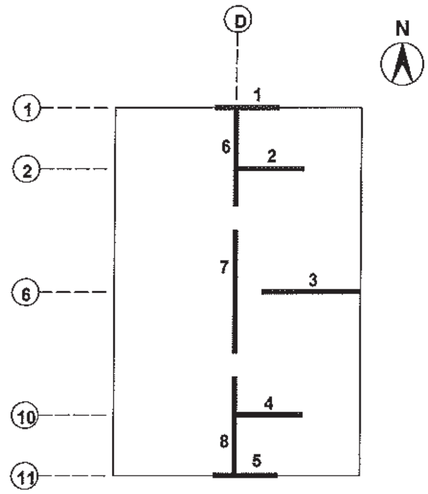

Figure 16 Shearwall identification and locations in NEESWood Capstone test building

8 Results of Non-linear Time History Analyses

For each building analysed, the following results are provided: a) natural frequency; b) maximum base shear; c), maximum displacement and acceleration at each storey; d) maximum inter-storey drift; e) maximum shearwall deformation at each storey; and f) maximum uplift forces and deformations. Detailed results of the representative building designed in accordance with 2006 BCBC and 2010 NBCC are provided in Appendix C and D, respectively. The results of NEESWood Capstone test building designed in accordance with 2006 BCBC are provided in Appendix E. Selected time history responses and hysteresis loops of selected shearwalls are provided in Appendix F.

8.1 Representative buildings designed in accordance with 2006 BCBC

A summary of the results of the representative 4-storey and 6-storey buildings designed in accordance with 2006 BCBC is provided in Tables 14 and 15. In general, it was found that for the same buildings, Drain-3D results show higher natural periods, greater base shear, larger maximum displacements and inter-storey drifts than results obtained with the SAPWood model. For that reason, results from the Drain-3D model will be used for discussion in this section.

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Table 14 Summary of mean results of 4-storey building designed in accordance with 2006 BCBC

4-storey building			Drain-3D				SAPWood			
			E-W		N-S		E-W		N-S	
Natural period (s)	With GWB		0.54		0.68		0.52			
	Without GWB		0.73		0.78		0.64			
Base shear (kN)	With GWB		1351		1037		959		845	
	Without GWB		981		893		951		832	
Storey →			1	2	3	4	1	2	3	4
Displacement (mm)	With GWB	E-W	28.7	45.6	59.5	66.4	17.5	32.2	43.3	47.3
		N-S	25.8	49.6	75.2	94.0	23.0	40.9	58.3	63.4
	Without GWB	E-W	28.8	46.3	72.3	80.2	21.5	40.9	60.8	70.5
		N-S	29.0	52.9	81.7	103.4	27.3	45.3	66.9	74.0
Inter-storey drift (%)	With GWB	E-W	1.04	0.64	0.57	0.29	0.64	0.57	0.46	0.19
		N-S	0.94	0.91	0.99	0.74	0.84	0.73	0.77	0.26
	Without GWB	E-W	1.05	0.70	1.08	0.39	0.83	0.74	0.76	0.26
		N-S	1.05	0.96	1.17	0.88	0.83	0.74	0.76	0.26
Shearwall deformation, (mm)	With GWB	E-W	27.5	15.5	12.9	5.0	na	na	na	na
		N-S	21.8	16.1	15.3	7.5	na	na	na	na
	Without GWB	E-W	28.2	18.2	28.4	9.0	na	na	na	na
		N-S	25.8	18.9	22.1	13.5	na	na	na	na
Uplift force (kN)	With GWB	E-W	48.4	27.5	10.4	5.1	53.7	28.9	22.3	11.1
		N-S	85.7	54.7	31.8	13.3	15.4	8.5	8.5	5.4
	Without GWB	E-W	6.4	1.9	0.6	0.7	53.7	28.9	22.3	11.1
		N-S	74.6	51.1	29.3	14.7	15.4	8.5	8.5	5.4
Uplift deformation (mm)	With GWB	E-W	1.69	1.75	0.65	0.11	1.90	2.01	1.55	0.77
		N-S	3.04	4.67	2.21	0.92	0.54	0.59	0.59	0.37
	Without GWB	E-W	0.23	0.14	0.04	0.05	1.90	2.01	1.55	0.77
		N-S	2.65	3.60	2.03	1.02	0.54	0.59	0.59	0.37

Note: For Drain-3D, the results of walls 4 and 25 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A (please refer to section 8.6 for explanation).

Table 15 Summary of mean results of 6-storey building designed in accordance with 2006 BCBC

6-storey Building			Drain-3D						SAPWood					
			E-W			N-S			E-W			N-S		
Natural period (s)	With GWB		0.78			0.96			0.66					
	Without GWB		0.99			1.07			0.89					
Base shear (kN)	With GWB		1665			1559			995			943		
	Without GWB		1410			1435			1065			1018		
Storey →			1	2	3	4	5	6	1	2	3	4	5	6
Displacement (mm)	With GWB	E-W	18.6	35.5	59.1	76.4	92.8	103.2	13.7	26.3	39.0	49.3	58.0	62.0
		N-S	23.0	43.4	64.5	92.6	124.3	150.8	18.6	33.8	46.9	59.1	72.2	76.2
	Without GWB	E-W	25.2	42.8	70.1	86.9	108.6	119.0	17.9	33.2	48.9	62.4	75.9	83.1
		N-S	23.8	44.2	64.3	89.8	122.4	149.2	19.8	36.8	51.1	66.4	81.1	86.8
Inter-storey drift (%)	With GWB	E-W	0.68	0.63	0.91	0.67	0.65	0.40	0.50	0.50	0.52	0.44	0.37	0.18
		N-S	0.84	0.77	0.87	1.16	1.34	1.05	0.68	0.61	0.58	0.62	0.67	0.24
	Without GWB	E-W	0.91	0.67	1.13	0.71	1.11	0.44	0.50	0.50	0.52	0.44	0.37	0.18
		N-S	0.87	0.78	0.82	1.19	1.49	1.12	0.50	0.50	0.52	0.44	0.37	0.18
Shear wall deformation, (mm)	With GWB	E-W	17.0	14.2	20.7	13.0	11.9	4.7	na	na	na	na	na	na
		N-S	19.1	13.3	11.4	14.8	16.5	7.8	na	na	na	na	na	na
	Without GWB	E-W	24.1	16.6	28.6	16.5	27.5	8.4	na	na	na	na	na	na
		N-S	20.3	14.6	12.4	18.5	24.6	14.4	na	na	na	na	na	na
Uplift force (kN)	With GWB	E-W	111.0	80.7	53.8	29.9	11.3	1.5	95.0	58.1	57.5	36.4	25.0	12.3
		N-S	148.9	115.7	85.5	54.8	32.1	11.0	28.9	26.6	16.8	11.4	8.2	4.5
	Without GWB	E-W	53.6	34.0	17.2	5.4	3.0	0.8	95.0	58.1	57.5	36.4	25.0	12.3
		N-S	136.6	101.4	74.9	51.6	30.7	14.1	28.9	26.6	16.8	11.4	8.2	4.5
Uplift deformation (mm)	With GWB	E-W	2.38	2.86	1.91	2.08	0.79	0.11	2.03	2.05	2.03	2.53	1.73	0.85
		N-S	3.88	2.49	3.03	4.99	2.23	0.77	0.62	0.57	0.59	0.79	0.57	0.31
	Without GWB	E-W	1.15	1.21	0.61	0.37	0.21	0.06	2.03	2.05	2.03	2.53	1.73	0.85
		N-S	3.06	2.18	2.66	3.93	2.13	0.98	0.62	0.57	0.59	0.79	0.57	0.31

Note: For Drain-3D, the results of walls 4 and 25 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A (please refer to section 8.6 for explanation).

8.1.1 Natural Periods

For the buildings analyzed, the natural period of the 4-storey building is approximately 0.5 - 0.6 seconds when GWB is considered in the analysis. The natural period of the same building becomes 0.6 - 0.8 seconds when only wood-based shear walls are considered. For 6-storey building, the natural period is approximately 0.6 - 0.9 seconds when GWB is considered and 0.9 - 1.1 seconds when only wood-based shear walls are considered. For both buildings, the natural periods are much greater than those calculated by the Code formula $0.05(h_n)^{3/4}$, according to which, the natural periods of the 4-storey and 6-storey buildings are 0.3 seconds and 0.41 seconds, respectively.

8.1.2 Base Shear

For the 4-storey building with GWB considered, the average base shears are 1351 kN in E-W direction and 1037 kN in N-S direction, which are 65% of the lateral load capacity of the first storey in E-W direction and 83% of the lateral load capacity of the first storey in N-S direction. When only the wood-based shearwalls are considered, the average base shears are 72% of the lateral load capacity of the first storey in E-W direction and 84% of the lateral load capacity of the first storey in N-S direction.

For the 6-storey building with GWB considered, the average base shears are 1665 kN in E-W direction and 1559 kN in N-S direction, which are 61% of the lateral load capacity of the first storey in E-W direction and 79% of the lateral load capacity of the first storey in N-S direction. For the same building with only wood-based shearwalls considered, the average base shears are approximately 71% of the lateral load capacity of the first storey in E-W direction and 80% of the lateral load capacity of the first storey in N-S direction.

8.1.3 Displacement at the Top of the Buildings

For the 4-storey buildings with GWB considered, the average maximum displacements at the top of the building are approximately 67 mm in E-W direction and 94 mm in N-S direction. Where GWB is not considered, the average maximum displacements at the top of the building are slightly increased, with 80 mm in E-W direction and 103 mm in N-S direction.

For the 6-storey buildings with GWB considered, the average maximum displacements at the top of the building are 103 mm in E-W direction and 151 mm in N-S direction. For the same building with only wood-based shearwalls considered, the average maximum displacements at the top of the building are 119 mm in E-W direction and 149 mm in N-S direction.

8.1.4 Inter-storey drifts

For 4-storey building when GWB is considered, the average maximum inter-storey drift, which occurs in the first storey, is approximately 1%. This is much smaller than the 2.5% maximum inter-storey drift allowed in 2006 BCBC. In addition, none of the maximum inter-storey drifts at any storey under any individual earthquake exceed 2.5% inter-storey limit. For 4-storey building when only wood-based shearwalls are considered, the average maximum inter-storey drift, which occurs in the third storey, is approximately 1.2%. Similarly, none of the maximum inter-storey drifts at any storey under any individual earthquake exceed the 2.5% inter-storey drift limit.

The same conclusions can be made for the 6-storey building. The average maximum inter-storey drifts, which occur at the fifth storey, are approximately 1.3% for building with GWB considered and 1.5% for building with only wood-based shearwalls considered. None of the maximum inter-storey drifts at any storey under any earthquake excitation exceed the 2.5% inter-storey limit.

Figures 17 and 18 show the cumulative distributions of maximum inter-storey drifts at each storey from the Drain-3D model. As noted, the distribution of maximum inter-storey drifts at 1 - 3 storey in 6-storey building are similar to those in the 4-storey building. For a 6-storey building, the maximum inter-storey drifts at 4 - 6 storey are much greater than those obtained at 1 - 3 storey.

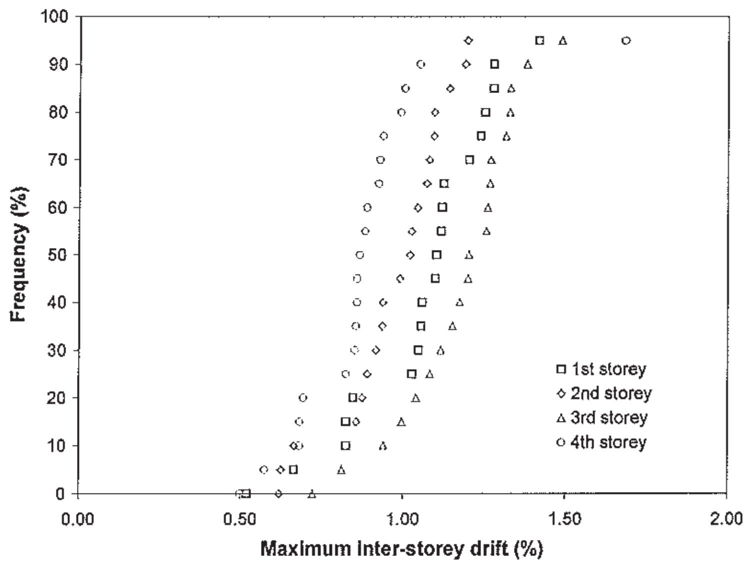

Figure 17 Cumulative distribution of inter-storey drifts in N-S direction for 4-storey buildings without GWB

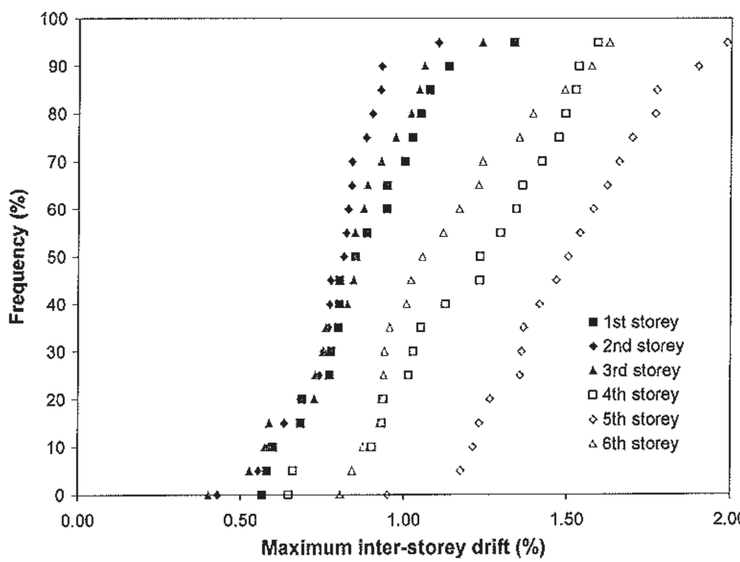

Figure 18 Cumulative distribution of inter-storey drifts in N-S direction for 6-storey buildings without GWB

8.1.5 Shearwall deformations

Figures 19 and 20 show the cumulative distributions of the maximum shearwall deformation at each storey from Drain-3D. As noted, the maximum shearwall deformation at 1 - 3 storey in 6-storey building is generally smaller than that in the 4-storey building. For the 6-storey building, the largest shearwall deformations occurred at the 5th storey. Other than the one which is 43 mm, the shearwall deformations at the 5th storey are similar to those at the 1st storey in the 4-storey building.

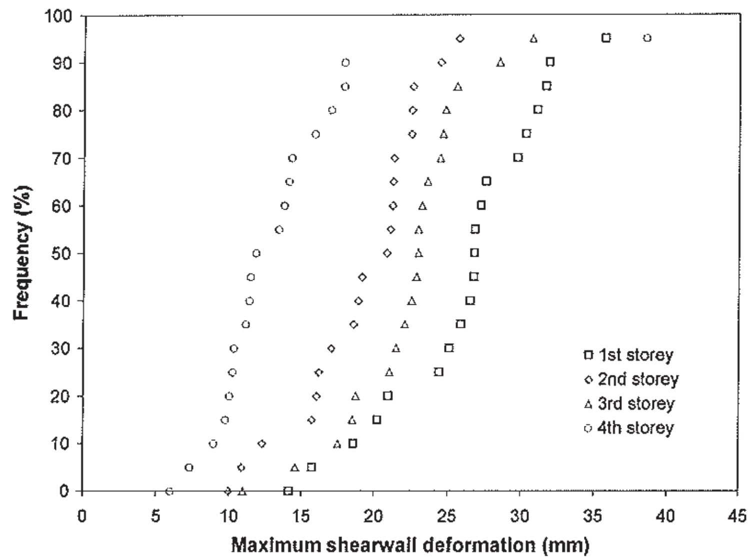

Figure 19 Cumulative distribution of shearwall deformations in N-S direction for 4-storey buildings without GWB

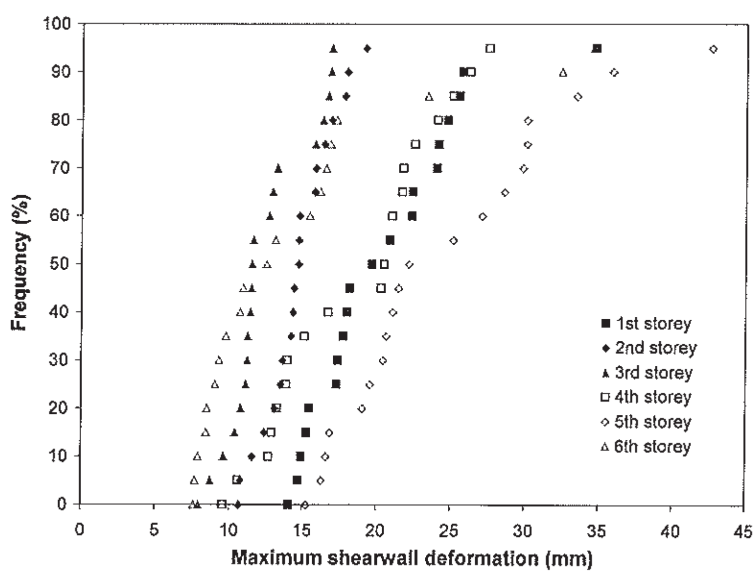

Figure 20 Cumulative distribution of shearwall deformations in N-S direction for 6-storey buildings without GWB

8.1.6 Hold-down Uplift Forces and Deformations

Large discrepancies were found between the results from Drain-3D and SAPWood. While hold-down stresses calculated by SAPWood did not reach the yield strength of the steel rods, hold-down stresses calculated by Drain-3D reached yield strength in N-S direction in several instances. The differences are believed mainly due to the assumptions used in the analyses. In Drain-3D, it is assumed that a) the lumped mass at each storey is equally distributed to the nodes of the floor, and b) floor out-of-plane is flexible.

In SAPWood two methods are used to calculate the maximum tension and compression forces of shearwalls. The first method (termed hereafter as method A) uses the maximum force values (tension and compression) experienced by the hold-down and the compression spring elements directly. The second method (termed hereafter as method B) takes the maximum shear force in each wall element and uses the free-body-diagram equilibrium (illustrated in Figure 21b) to find the tension and compression at each end. Method A considers the over-turning effect of the entire building (as is shown in Figure 21a), thus resulting in high tension/compression forces in the hold-downs and studs close to the edge of the diaphragm. It has been proven to be accurate when the global out-of-plane rotation of the entire diaphragm is significant (Pei and van de Lindt, 2008). However, it does not take into account the out-of-plane flexibility of the diaphragm, i.e. it assumes that the diaphragm will rotate as a rigid plate. Thus it might underestimate the forces for the shearwalls located near the center of the floor plan. On the other hand, method B calculates the tension/compression for each wall individually following basic force equilibrium with no consideration of the overall (global) behaviour of the diaphragm. This is the approach used in current force-based design practice such as IBC (2006) to calculate the hold-down forces. It is believed that the maximum hold-down/stud forces in reality are bounded by these two methods.

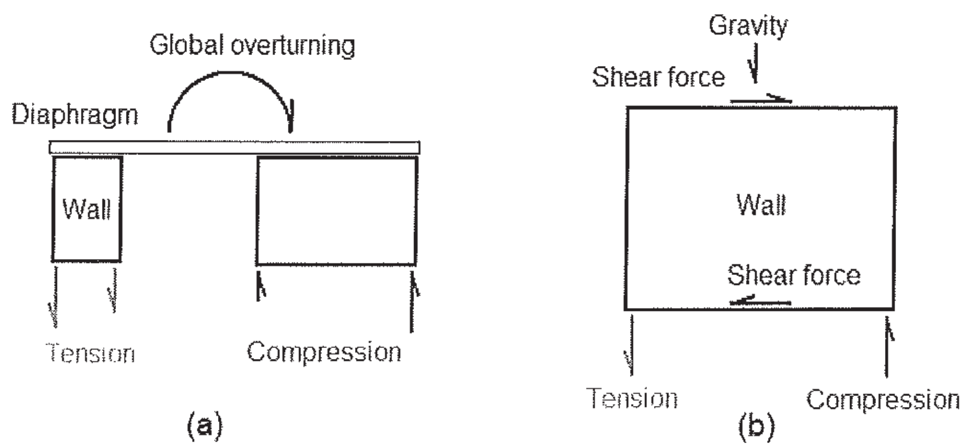

Figure 21 Force equilibrium assumptions for Method A and B

8.2 Representative building designed in accordance with 2010 NBCC

A summary of the results of a representative 4-storey and 6-storey building designed in accordance with 2010 NBCC is provided in Tables 16 and 17. The results are similar to those of 4-storey and 6-storey buildings designed in accordance with 2006 BCBC. This was expected, as except for a few hold-downs, shearwalls in 4-storey and 6-storey buildings designed in accordance with 2006 BCBC and 2010 NBCC are identical. Therefore, observations and conclusions for the buildings designed in accordance with 2006 BCBC also apply to the buildings designed in accordance to 2010 NBCC.

Table 16 Summary of mean results of 4-storey building designed in accordance with 2010 NBCC

4-storey building with GWB		Drain-3D				SAPWood			
		E-W		N-S		E-W		N-S	
Natural period (s)		0.54		0.68		0.52			
Base shear (kN)		1351		1053		938		842	
Storey →		1	2	3	4	1	2	3	4
Displacement (mm)	E-W	28.6	45.5	59.4	66.2	17.6	32.2	43.5	47.5
	N-S	28.0	50.9	75.1	91.3	22.8	40.9	58.3	63.5
Inter-storey drift (%)	E-W	1.04	0.64	0.57	0.28	0.64	0.57	0.47	0.18
	N-S	1.02	0.86	0.94	0.65	0.83	0.74	0.76	0.26
Shearwall deformation, (mm)	E-W	27.4	15.7	13.1	5.0	na	na	na	na
	N-S	23.9	16.7	16.0	7.2	na	na	na	na
Uplift force (kN)	E-W	48.4	27.5	10.4	5.1	53.2	38.8	22.1	11.3
	N-S	88.4	58.8	31.8	12.7	15.5	12.2	8.5	5.5
Uplift deformation (mm)	E-W	1.71	0.93	0.66	0.11	1.88	1.37	1.53	0.78
	N-S	3.14	2.09	2.21	0.88	0.55	0.43	0.59	0.38

Note: For Drain-3D, the results of walls 4 and 25 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A.

Table 17 Summary of mean results of 6-storey building designed in accordance with 2010 NBCC

6-storey building with GWB		Drain-3D						SAPWood					
		E-W			N-S			E-W			N-S		
Natural period (s)		0.78			0.96			0.66					
Base shear (kN)		1665			1583			987			938		
Storey →		1	2	3	4	5	6	1	2	3	4	5	6
Displacement (mm)	E-W	18.6	35.5	58.5	76.4	92.8	103.1	18.6	33.8	46.9	59.1	72.2	76.2
	N-S	23.4	44.1	67.0	95.4	127.6	152.4	13.8	26.4	39.0	49.4	58.1	62.0
Inter-storey drift (%)	E-W	0.68	0.63	0.92	0.67	0.65	0.40	0.50	0.50	0.52	0.43	0.38	0.17
	N-S	0.87	0.89	1.10	1.42	1.74	1.52	0.68	0.61	0.58	0.62	0.66	0.23
Shear wall deformation (mm)	E-W	17.0	14.2	20.8	13.1	11.9	4.7	na	na	na	na	na	na
	N-S	20.0	13.7	13.2	16.7	19.0	8.0	na	na	na	na	na	na
Uplift force (kN)	E-W	110.9	80.6	53.7	29.6	11.2	1.7	94.7	56.5	56.6	26.4	24.3	11.6
	N-S	162.0	124.0	89.8	63.2	34.8	13.1	27.8	25.7	15.9	15.1	7.9	4.3
Uplift deformation (mm)	E-W	2.38	2.86	1.90	2.05	0.78	0.11	2.03	2.00	2.00	1.83	1.69	0.81
	N-S	3.47	2.65	3.50	2.32	2.40	0.90	0.59	0.55	0.56	0.53	0.55	0.30

Note: For Drain-3D, the results of walls 4 and 25 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A.

8.3 NEESWood Capstone test building designed in accordance with 2010 NBCC

A summary of the results of the NEESWood Capstone 4-storey and 6-storey building designed in accordance with 2010 NBCC is provided in Tables 18 and 19.

Table 18 Summary of mean results of 4-storey building designed in accordance with 2010 NBCC

4-storey building with GWB		Drain-3D				SAPWood			
		E-W		N-S		E-W		N-S	
Natural period (s)		0.59		0.78		0.70			
Base shear (kN)		426		276		237		209	
Storey ⟶		1	2	3	4	1	2	3	4
Displacement (mm)	E-W	12.9	26.8	51.0	100.9	17.7	32.7	48.6	72.2
	N-S	24.6	38.7	76.1	89.3	23.0	39.5	60.2	72.7
Inter-storey drift (%)	E-W	0.47	0.53	0.95	2.30	0.64	0.69	0.74	1.05
	N-S	0.90	0.60	1.62	0.54	0.84	0.84	1.03	0.61
Shearwall deformation, (mm)	E-W	7.8	5.3	10.6	47.3	na	na	na	na
	N-S	22.5	12.1	39.9	9.5	na	na	na	na
Uplift force (kN)	E-W	219	163	114	47	109.5	65.7	43.6	20.2
	N-S	93	59	30	6.4	41.0	22.8	15.2	16.4
Uplift deformation (mm)	E-W	4.7	3.5	8.1	3.2	2.34	2.06	1.37	1.40
	N-S	3.3	2.1	2.1	0.4	1.45	1.40	0.94	1.14

Note: For Drain-3D, the results of walls 5 and 8 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A.

Table 19 Summary of mean results of 6-storey building designed in accordance with 2010 NBCC

6-storey building with GWB		Drain-3D						SAPWood					
		E-W			N-S			E-W			N-S		
Natural period (s)		0.87			0.94			1.04					
Base shear (kN)		460			480			295			242		
Storey ⟶		1	2	3	4	5	6	1	2	3	4	5	6
Displacement (mm)	E-W	17.6	37.1	60.4	88.3	117.3	154.3	14.3	25.9	38.8	52.9	66.6	84.7
	N-S	15.9	31.0	61.8	85.3	112.1	143.4	19.7	34.7	50.2	62.3	73.9	86.0
Inter-storey drift (%)	E-W	0.64	0.74	0.90	1.09	1.12	1.51	0.52	0.55	0.62	0.71	0.69	0.90
	N-S	0.58	0.57	1.22	0.90	1.10	1.39	0.72	0.74	0.80	0.70	0.70	0.75
Shear wall deformation (mm)	E-W	11.0	8.0	7.2	7.9	7.0	16.9	na	na	na	na	na	na
	N-S	12.3	8.4	23.9	13.1	17.1	26.4	na	na	na	na	na	na
Uplift force (kN)	E-W	298	240	179	148	98	84	113.8	103.3	79.4	78.5	69.3	42.8
	N-S	245	177	136	87	42	10	76.3	63.5	51.8	32.4	15.1	9.8
Uplift deformation (mm)	E-W	6.4	5.1	5.2	3.2	2.2	1.8	2.44	1.96	1.51	1.49	1.32	0.92
	N-S	5.3	5.4	2.9	3.1	2.9	0.7	1.63	1.21	0.99	1.02	0.93	0.68

Note: For Drain-3D, the results of walls 5 and 8 are presented in E-W and N-S, respectively.
For SAPWood, the uplift forces in the table are based on Method A.

8.3.1 Natural Periods

Only wood-based shear walls are considered in the analysis. The natural period is approximately 0.6 - 0.8 seconds for the 4-storey building and approximately 0.9 - 1.1 seconds for the 6-storey building. The results again demonstrate that the natural periods are much greater than those calculated by the Code formula $0.05(h_n)^{3/4}$. Although GWB would increase building stiffness and therefore reduce the natural period, it is believed that GWB would fail in a severe earthquake event. As natural period is primarily used to calculate maximum base shear of a building, it seems reasonable to ignore the GWB contribution.

8.3.2 Base Shear

The base shears obtained from Drain-3D are much greater than those obtained from SAPWood. For the 4-storey building, the average base shears obtained from Drain-3D are 426 kN in E-W direction and 276 kN in N-S direction, which are 64% of the lateral load capacity of the first storey in E-W direction and 62% of the lateral load capacity of the first storey in N-S direction. The average base shears obtained from SAPWood are approximately 36% of the lateral load capacity of the first storey in E-W direction and 47% of the lateral load capacity of the first storey in N-S direction.

For the 6-storey building, the average base shears obtained from Drain-3D are 460 kN in E-W direction and 480 kN in N-S direction, which are 66% of the lateral load capacity of the first storey in E-W direction and 72% of the lateral load capacity of the first storey in N-S direction. The average base shears obtained from SAPWood are approximately 42% of the lateral load capacity of the first storey in E-W direction and 36% of the lateral load capacity of the first storey in N-S direction.

8.3.3 Inter-storey drifts

For the 4-storey building, the average maximum inter-storey drift obtained from SAPWood is approximately 1.05% at the fourth storey. This is much smaller than the 2.5% maximum inter-storey drift allowed in 2010 NBCC. None of the maximum inter-storey drifts at any storey under any of the 20 earthquake excitation exceed the 2.5% inter-storey limit. When analysed with Drain-3D, though they are compatible to the results of SAPWood in N-S direction, the average maximum inter-storey drift in E-W direction reached approximately 2.3% at the fourth storey, which is close to the 2.5% maximum inter-storey drift allowed in 2010 NBCC. Of the twenty earthquakes examined, with Drain-3D approximately half of the earthquakes resulted in the maximum inter-storey drifts greater than 2.5% inter-storey limit. It is believed that the different results are mainly due to the large hold-down deformations obtained in analyses with DRAIN-3D. As mentioned in Section 8.1.6, it is assumed in Drain-3D that: a) lumped mass at each storey is equally distributed to the nodes of the floor, and b) floor out-of-plane is flexible. Such assumptions will result in much higher hold-down stresses than it would happen in a real building. For the 4-storey building analysed with Drain-3D, hold-downs reached yield strength under most of earthquake excitations and consequently had much larger uplift deformations.

For the 6-storey building, the average maximum inter-storey drifts obtained from SAPWood and DRAIN-3D are approximately 0.9% and 1.51% at the sixth storey, respectively. This is much smaller than the 2.5% maximum inter-storey drift allowed in 2010 NBCC. Of the twenty earthquakes examined, none of the maximum inter-storey drifts at any storey under any earthquake excitation exceed the 2.5% inter-storey limit.

8.3.4 Shearwall deformations

For the 4-storey building, the average maximum shearwall deformation is around 46 mm at the fourth storey in E-W direction and 40 mm at the third storey in N-S direction. These are less than the displacement at peak load of the shear walls. Where individual earthquakes are concerned, the maximum deformation reached 70 mm in one case, which is greater than the displacement at peak load but still less than the ultimate displacement of the wall. The ultimate displacement of the wall is defined as the displacement which corresponds to 80% of the maximum lateral force on the descending portion of the force–deformation envelope curve. As the ultimate displacement of the walls can be treated as one of the criteria for wall reaching its "near-collapse" status, it means that the building will still stand if the maximum shearwall deformation is less than the ultimate displacement of the wall.

For the 6-storey building, the average maximum shearwall deformation is around 17 mm at the sixth storey in E-W direction and 26 mm at the sixth storey in N-S direction. These are much smaller than the average maximum shearwall deformation in the 4-storey building.

8.3.5 Hold-down Uplift Forces and Deformations

As for the representative wood-frame buildings, large discrepancies were found between the results from Drain-3D and SAPWood for the NEESWood building as well. While during analyses using SAPWood the hold-downs did not reach the yield strength, some of the hold-downs in the analyses using Drain-3D reached the yield strength in both E-W and N-S directions. The differences are due to the assumptions that lumped mass at each storey is equally distributed to the nodes of the floor in the Drain-3D model. As a result, the total weight to counteract the uplift force at the ends of a wall in the DRAIN-3D model is probably much smaller than that in the design, causing hold-downs in the model to yield under the earthquake excitation. In seismic surveys and shake table tests, the excessive deformations of hold-downs have not been observed.

9 Conclusions

Two building configurations, a typical wood-frame residential building and a building to be tested under the NEESWood project, were studied. For each building configuration, a four-storey building and a six-storey building were designed to the current (pre-April 6, 2009) 2006 BC Building Code (BCBC) and to the anticipated new requirements in the 2010 National Building Code of Canada (NBCC), resulting in four buildings with different designs. The four-storey building designed to the current 2006 BC Building Code served as the benchmark building representing the performance of current permissible structures with common architectural layouts. In the design of the two buildings, the fundamental lateral period was determined based on actual mass and stiffness of wood-based shearwalls. The base shear and inter-storey drift are determined in accordance with Clauses 4.1.8.11.(3)(d)(iii) and 4.1.8.11.(3)(d)(iv) of BCBC, respectively.

In 2006 BCBC and 2010 NBCC, the inter-storey drift limit is set at 2.5 % of the storey height for the very rare earthquake event (1 in 2475 year return period). Limiting inter-storey drift is a key parameter for meeting the objective of live safety under a seismic event.

For 4-storey and 6-storey representative wood-frame buildings, where only wood-based shearwalls are considered, results from both DRAIN-3D and SAPWood show that none of the maximum inter-storey drifts at any storey under any individual earthquake exceed the 2.5% inter-storey drift limit given in the building code. With DRAIN-3D, the average maximum inter-storey drifts are approximately 1.2% and 1.5% for 4-storey and 6-storey buildings designed with 2006 BCBC, respectively.

For NEESWood wood-frame buildings, none of the maximum inter-storey drifts at any storey under any individual earthquake exceed the 2.5% inter-storey drift limit for 4-storey building obtained from SAPWood and 6-storey building obtained from DRAIN-3D and SAPWood. For 4-storey building analysed with DRAIN-3D, approximately half of the earthquakes resulted in the maximum inter-storey drifts greater than 2.5% inter-storey limit. This is partly due to the assumptions used in Drain-3D in which lumped mass at each storey is equally distributed to the nodes of the floor. As a result, the total weight to counteract the uplift force at the ends of a wall would be much smaller than that anticipated in the design, causing hold-downs to yield and have large uplift deformations.

Based on the analyses that were carried out on a representative building and redesigned NEESWood building situated in the city of Vancouver, the results indicate that when subjected to the 20 earthquake records the 6-storey wood-frame buildings have similar or smaller inter-storey drift than the 4-storey wood-frame buildings which are allowed under the current building code and are used as a benchmark in this study.

10 References

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Karacabeyli, E., Ceccotti, A. 1996. "Test results on the lateral resistance of nailed shear walls. Proceedings of the International Wood Engineering Conference", 1996 Oct 28–31; New Orleans, LA. Vol.2, 179-186.

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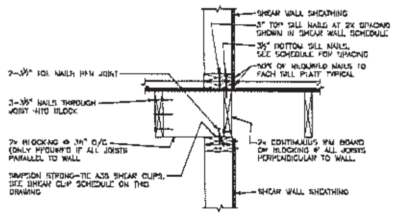
Appendix A

Design drawings of 4 and 6 storey Buildings

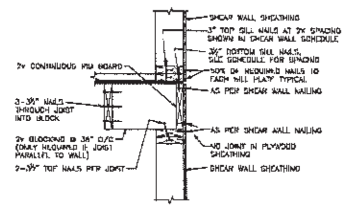
Confidential

A-1) Design drawings of representative 4-storey building designed in accordance with 2006 BCBC



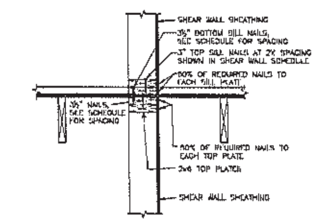
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



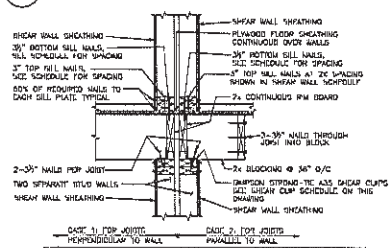
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL
1" = 1'-0"



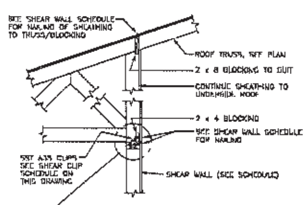
NOTES:
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS ALTERNATE WHERE ALL JOISTS PARALLEL TO INTERIOR WALL
1" = 1'-0"

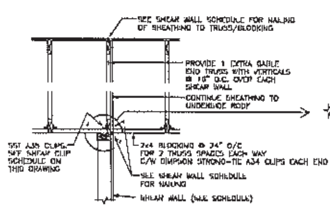


NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

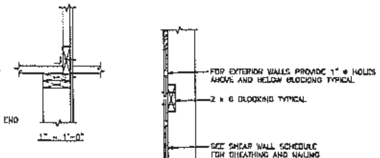
TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT PARTY WALL
1" = 1'-0"



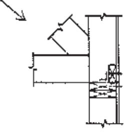
TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL
1/2" = 1'-0"

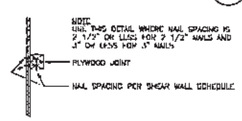


TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL
1/2" = 1'-0"



TYPICAL SHEAR WALL BLOCKING DETAIL
1" = 1'-0"





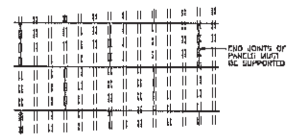
TYPICAL SHEAR WALL DOUBLE STUD DETAIL AT VERTICAL PLYWOOD JOINT
1" = 1'-0"

NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 15%) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE ≤ 15%) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS, STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE	
TOP OF FLOOR	2006 (4 STOREYS)
4TH FLOOR	A35 @ 24" O/C
3RD FLOOR	A35 @ 18" O/C
2ND FLOOR	A35 @ 18" O/C
1ST FLOOR	A35 @ 12" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   [– ALBERTA BUILDING CODE 2006 – PART 9]
   [– BRITISH COLUMBIA BUILDING CODE 2006 – PART 9]
   [– ONTARIO BUILDING CODE 2006 – PART 9]
   [– VANCOUVER BUILDING BYLAW – PART 9 (THE BUILDING CODE)]
   – CAN/CSA-O86 – ENGINEERING DESIGN IN WOOD
   – CSA O121 – DOUGLAS FIR PLYWOOD
   – CAN/CSA-LO 4000 PARALLAMS AND MICROLLAMS
   – CAN/CSA-O122 – STRUCTURAL GLUED-LAMINATED TIMBER
   – CAN O177 – QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   – CSA O437 – STRANDBOARD AND WAFERBOARD
   – CSA B111 – WIRE NAILS, SPIKES AND STAPLES
   – CAN/CSA-B34 MISCELLANEOUS BOLTS AND SCREWS
   – CANADIAN WOOD-FRAME HOUSE CONSTRUCTION–CMHC
   – "WOOD DESIGN MANUAL" – CANADIAN WOOD COUNCIL
   – "WOOD BUILDING TECHNOLOGY" – CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   A. FLOORS – NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   B. WALLS – NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. – NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   C. OVERALL – BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE D. FIR NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE D. FIR # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE. WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.6 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.

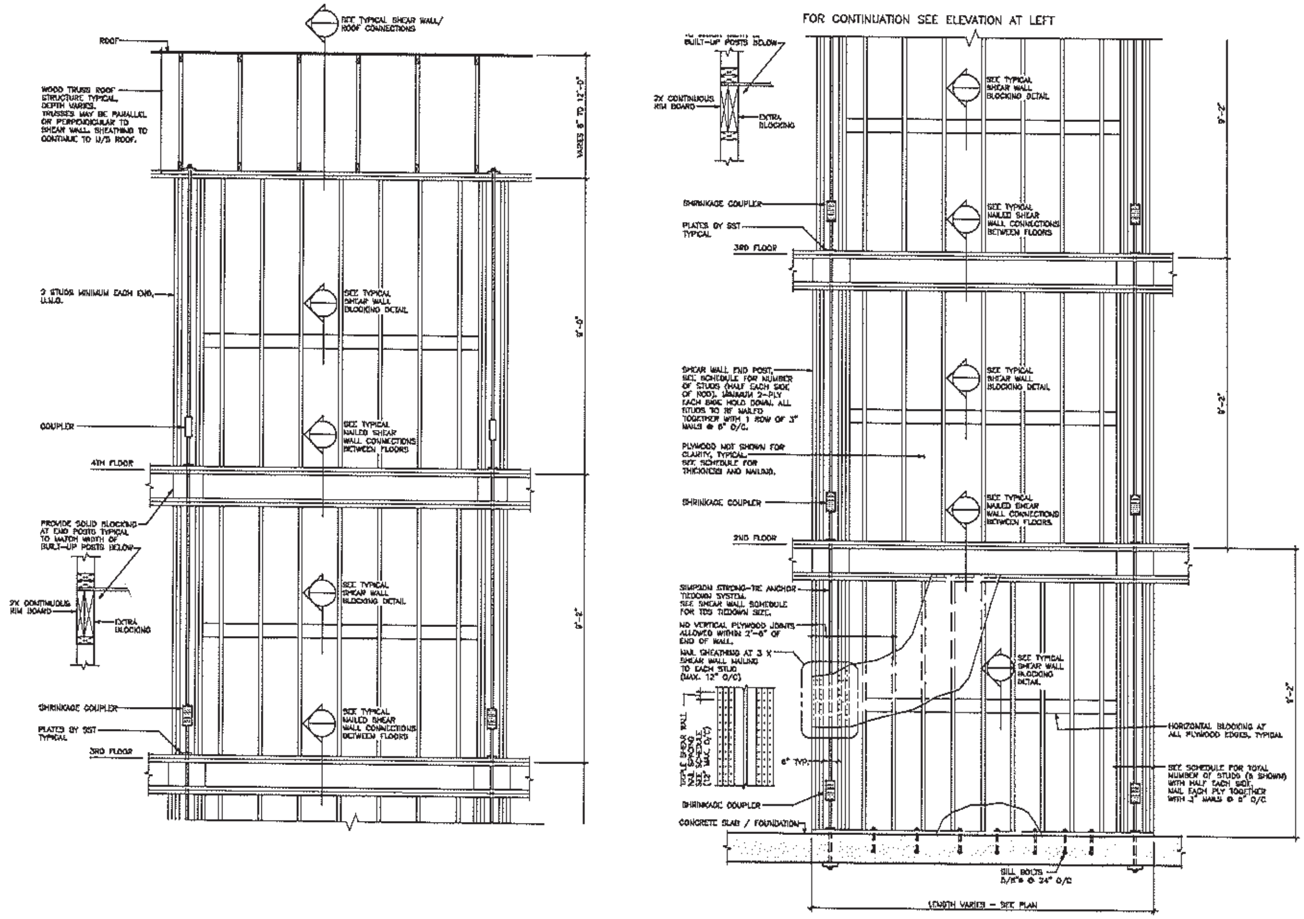
rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREYS
BCBC 2006

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2006-4-S-101	.

Appendix A – 3



4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0"
(TO BE USED AS A GUIDE ONLY)

Shear Wall Schedule - 4 Story Building 2006 BCBC	SW1	SW2	SW3	SW4
Level 4				
Hold Down	SR5	SR5	SR5	SR5
Posts	4-2x4	4-2x4	4-2x4	4-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	6"	6"	6"	6"
Level 3				
Hold Down	SR7	SR6	SR5	SR6
Posts	4-2x4	4-2x4	4-2x4	4-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	6"	4"	6"	6"
Level 2				
Hold Down	SR8	SR7	SR6	SR5
Posts	6-2x4	6-2x4	6-2x4	6-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"
Level 1				
Hold Down	SR8	SR7	SR7	SR7
Posts	6-2x4	6-2x4	6-2x4	6-2x4
Sheathing	3/8	4/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level

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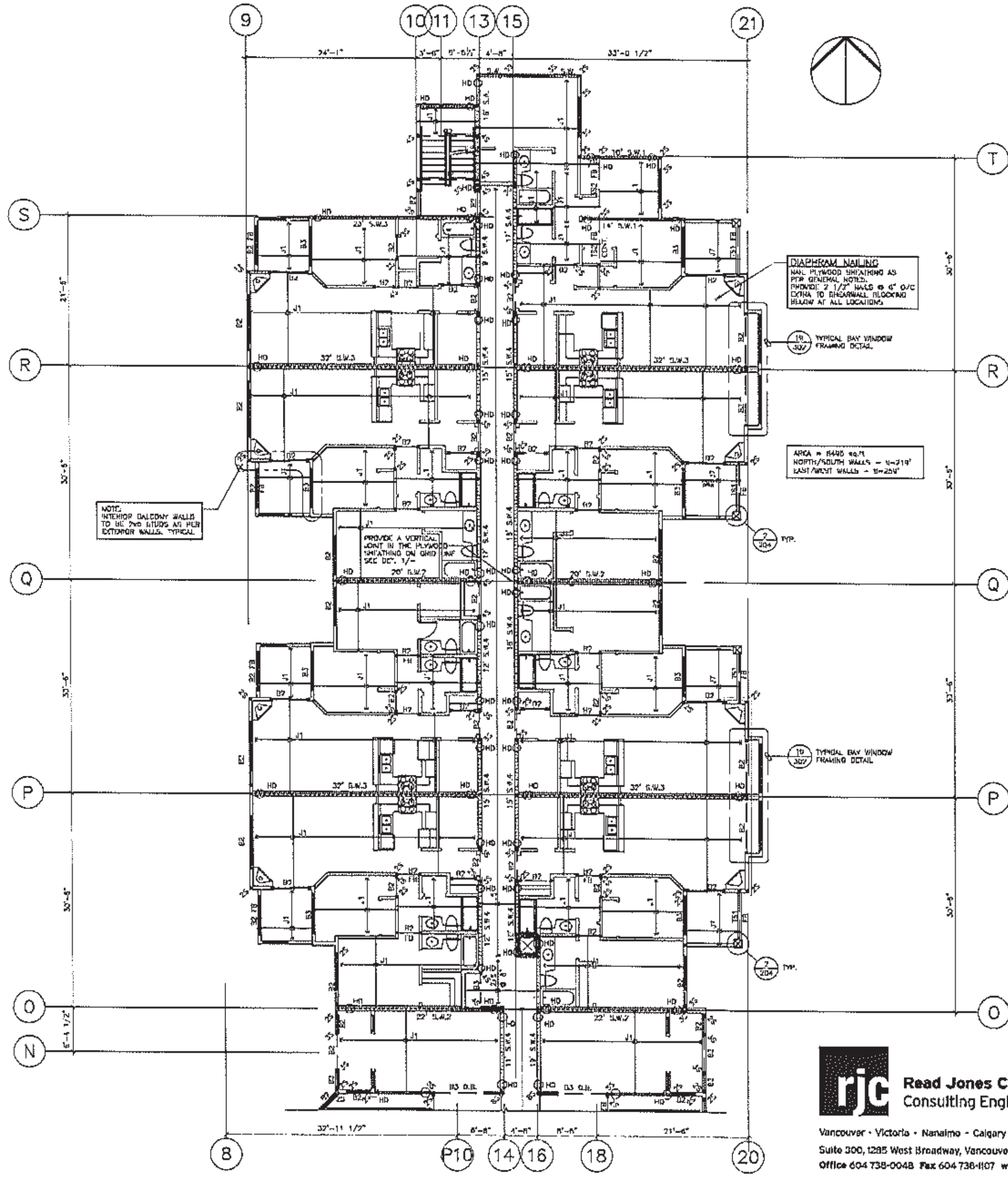
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca 1

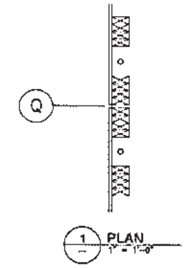
FORINTEK STUDY
4 STOREYS
BCBC 2006

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2006	1000793.0001	2006-4-S-102	.

Appendix A – 4





1 PLAN
1" = 1'-0"

BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN LUMBER (KILN DRIED) & GLULAM BEAMS
TS1 = 3 1/2" x 7 1/4" DP.	PB1 = 3 1/2" x 9 1/2" DP.	B2 = 2 - 2 x 10
TS2 = 3 1/2" x 9 1/2" DP.	PB2 = 3 1/2" x 11 7/8" DP.	B3 = 3 - 2 x 10
TS3 - 3 1/2" x 11 7/8" DP.	PB3 - 3 1/2" x 14" DP.	B4 - 4 - 2 x 10
	PB4 = 5 1/4" x 9 1/2" DP.	B2A = 2 - 2 x 12
	PB5 = 5 1/4" x 11 7/8" DP.	B3A = 3 - 2 x 12
	PB6 = 5 1/4" x 14" DP.	B4A = 4 - 2 x 12
	PB7 = 5 1/4" x 16" DP.	GB-1 = 5 1/8 x 9 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM
		GB-2 = 5 1/8 x 10 1/2 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM

1. — — INDICATES BEAM. PROVIDE BEAM [TS1] [B1] OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL 5/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS:
S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SAME SIDE OF WALL, U.N.O.
CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102. NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 = 2 x 10 JOISTS @ 12"
J3 = 2-2 x 10 JOISTS @ 16"
J4 = 2-2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 = 2 x 8 JOISTS @ 12"
J7 – 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

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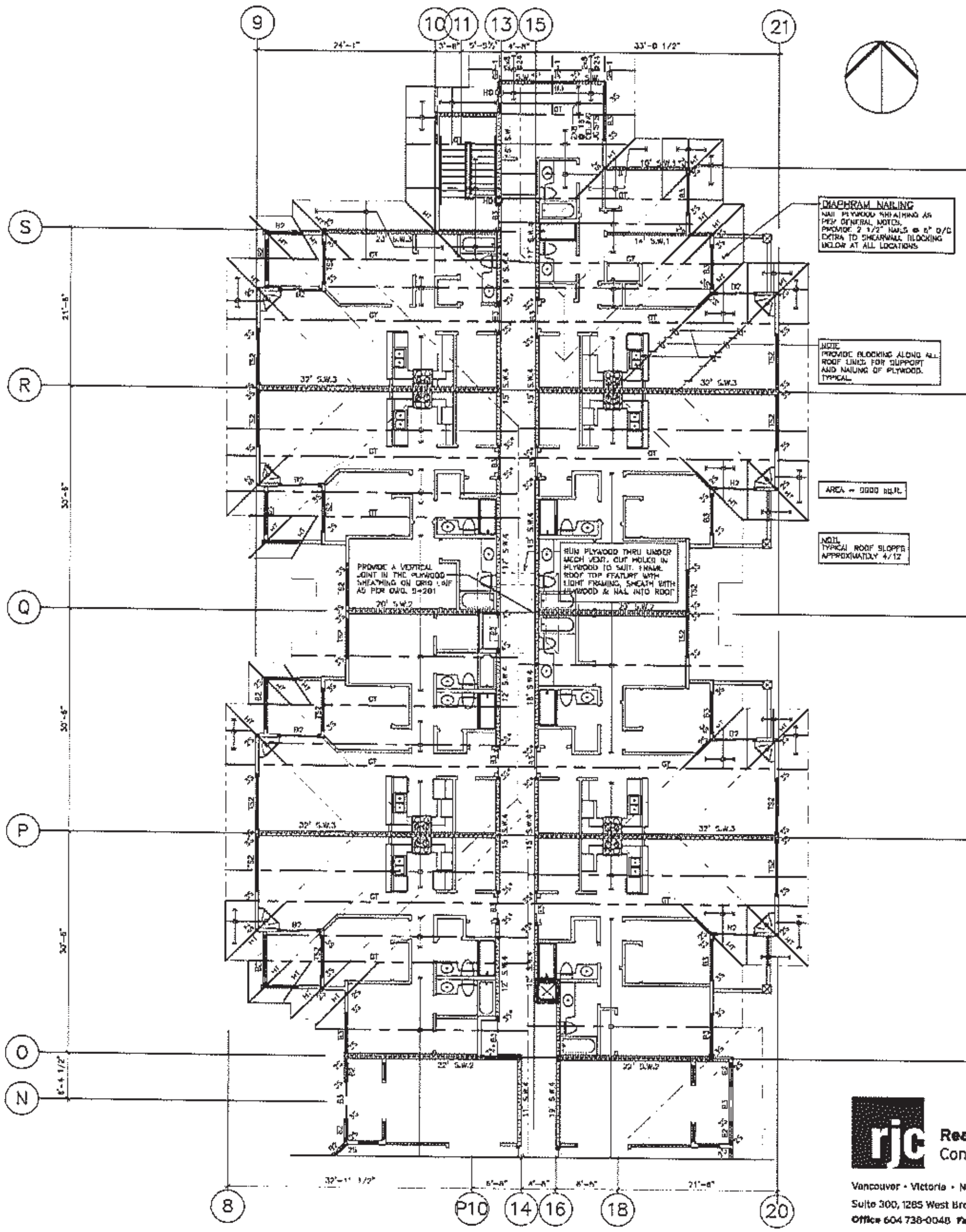
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREYS
BCBC 2006

Level 2 to 4 Framing

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2006-4-S-201	.

Appendix A – 5



BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN LUMBER (KILN DRIED) & GLULAM BEAMS
TB1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TB2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TB3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GB-1 – 5 1/8 x 9 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM
		GB-2 – 5 1/8 x 10 1/2 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM

1. —— INDICATES BEAM. PROVIDE BEAM [TB1] [B1] OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/100 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102. NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS.

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2-2 x 10 JOISTS @ 16"
J4 – 2-2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 6 JOISTS @ 16"

NOTES
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

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4 STOREYS
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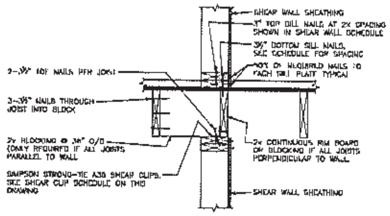
Roof Plan

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2006-4-S-202	.

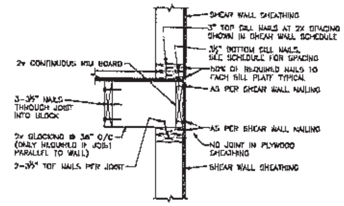
Appendix A – 6

A-2) Design drawings of representative 6-storey building designed in accordance with 2006 BCBC



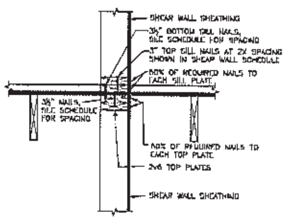
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



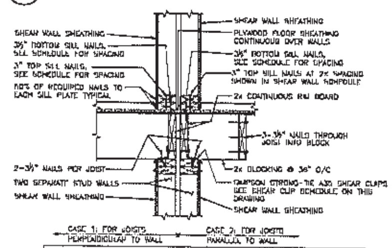
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL
1" = 1'-0"



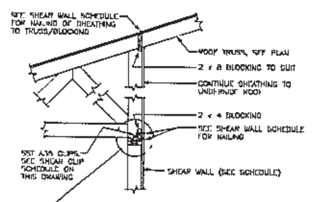
NOTES:
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS ALTERNATE WHERE ALL JOISTS PARALLEL TO INTERIOR WALL
1" = 1'-0"

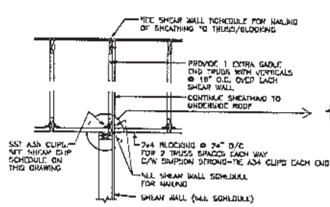


NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

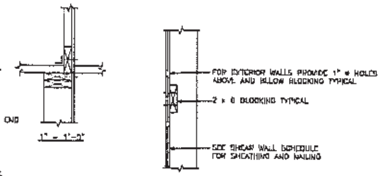
TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT PARTY WALL
1" = 1'-0"



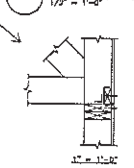
TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL
1/2" = 1'-0"

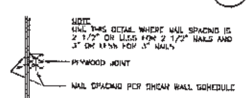


TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL
1/2" = 1'-0"



TYPICAL SHEAR WALL BLOCKING DETAIL
1" = 1'-0"





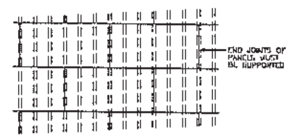
TYPICAL SHEAR WALL DOUBLE STUD DETAIL AT VERTICAL PLYWOOD JOINT
1" = 1'-0"

NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 15%) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE < 15%) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS. STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE

TOP OF FLOOR	2006 (6 STOREYS)
6TH FLOOR	A35 @ 24" O/C
5TH FLOOR	A35 @ 24" O/C
4TH FLOOR	A35 @ 16" O/C
3RD FLOOR	A35 @ 12" O/C
2ND FLOOR	A35 @ 12" O/C
1ST FLOOR	A35 @ 12" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   [– ALBERTA BUILDING CODE 2006 – PART 9]
   [– BRITISH COLUMBIA BUILDING CODE 2006 – PART 9]
   [– ONTARIO BUILDING CODE 2006 – PART 9]
   [– VANCOUVER BUILDING BYLAW – PART 9 (THE BUILDING CODE)]
   – CAN/CSA-O86 – ENGINEERING DESIGN IN WOOD
   – CSA O121 – DOUGLAS FIR PLYWOOD
   – CAN/CSA-40 4000 PARALLAMS AND MICROLLAMS
   – CAN/CSA-O122 – STRUCTURAL GLUED-LAMINATED TIMBER
   – CAN O177 – QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   – CSA O437 – STRANDBOARD AND WAFERBOARD
   – CSA B111 – WIRE NAILS, SPIKES AND STAPLES
   – CAN/CSA-B34 MISCELLANEOUS BOLTS AND SCREWS
   – CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC
   – "WOOD DESIGN MANUAL" – CANADIAN WOOD COUNCIL
   – "WOOD BUILDING TECHNOLOGY" – CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM, REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   A. FLOORS – NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   B. WALLS – NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. – NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   C. OVERALL – BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE D. FIR NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE D. FIR # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE. WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC, COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.8 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.

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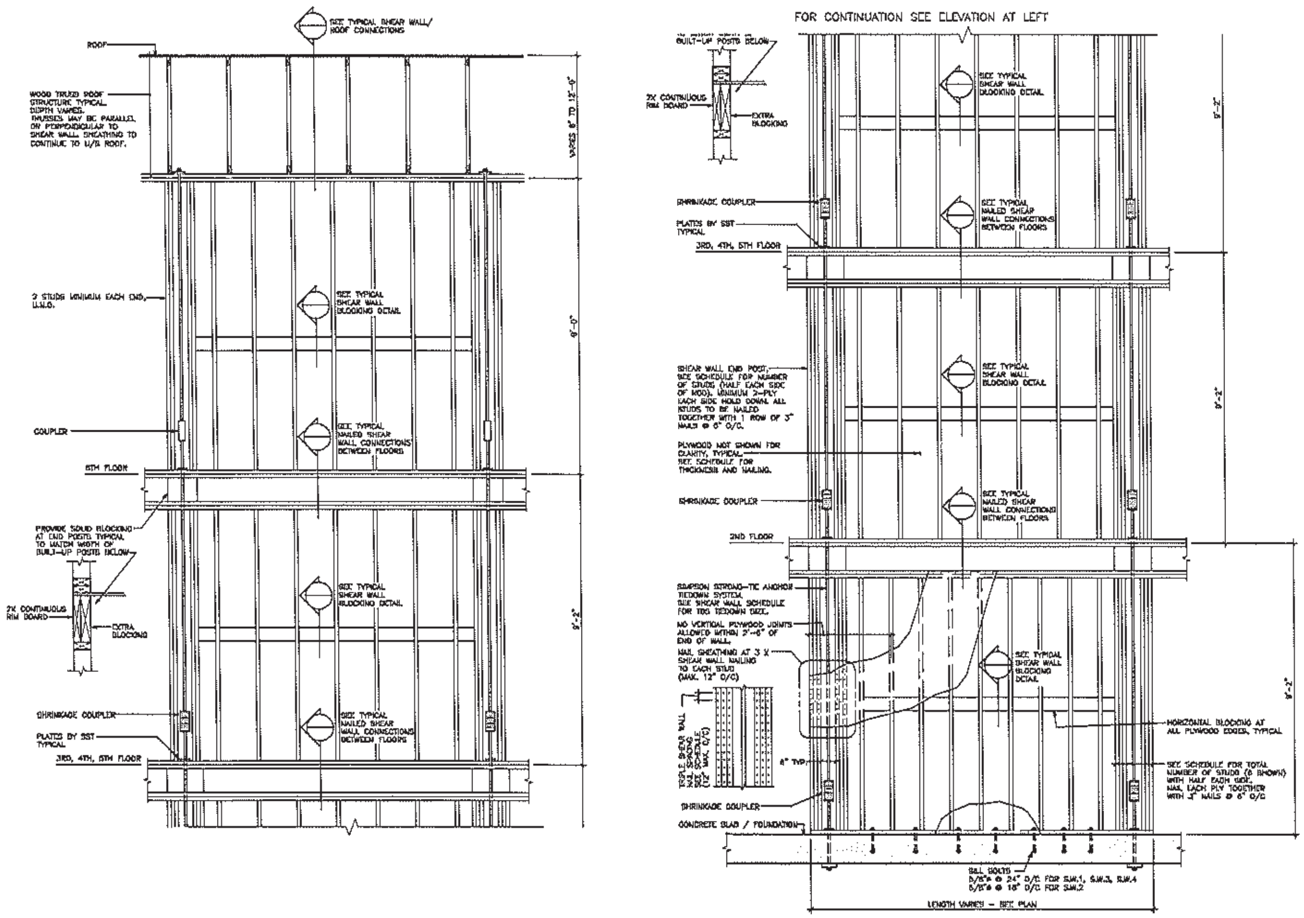
FORINTEK STUDY
6 STOREYS
BCBC 2006

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2006-6-S-101	

Appendix A – 8



4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0"
(TO BE USED AS A GUIDE ONLY)

Shear Wall Schedule - 6 Story Building 2006 BCBC				
	SW1	SW2	SW3	SW4
Level 6				
Hold Down	SR9	SR5	SR5	SR5
Posts	6-2x4	4-2x4	4-2x4	4-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	6"	6"	6"	6"
Level 5				
Hold Down	SR9	SR5	SR5	SR5
Posts	6-2x4	4-2x4	4-2x4	4-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	6"	4"	6"	6"
Level 4				
Hold Down	SR9	SR9	SR5	SR5
Posts	8-2x4	6-2x4	6-2x4	6-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"
Level 3				
Hold Down	SR10	SR7	SR7	SR7
Posts	8-2x4	8-2x4	6-2x4	8-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	3	2.5	2.5
Nail Spacing	4"	3"	4"	3"
Level 2				
Hold Down	SR10	SR9	SR7	SR9
Posts	8-2x4	8-2x4	8-2x4	8-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	3	2.5	2.5
Nail Spacing	3"	3"	3"	2.5"
Level 1				
Hold Down	SR10	SR9	SR9	SR9
Posts	8-2x4	8-2x6	8-2x4	8-2x6
Sheathing	4/8	4/8	4/8	1/2
Nail L	2.5	3	2.5	2.5
Nail Spacing	3"	2.5"	3"	2.5"

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level

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General Notes

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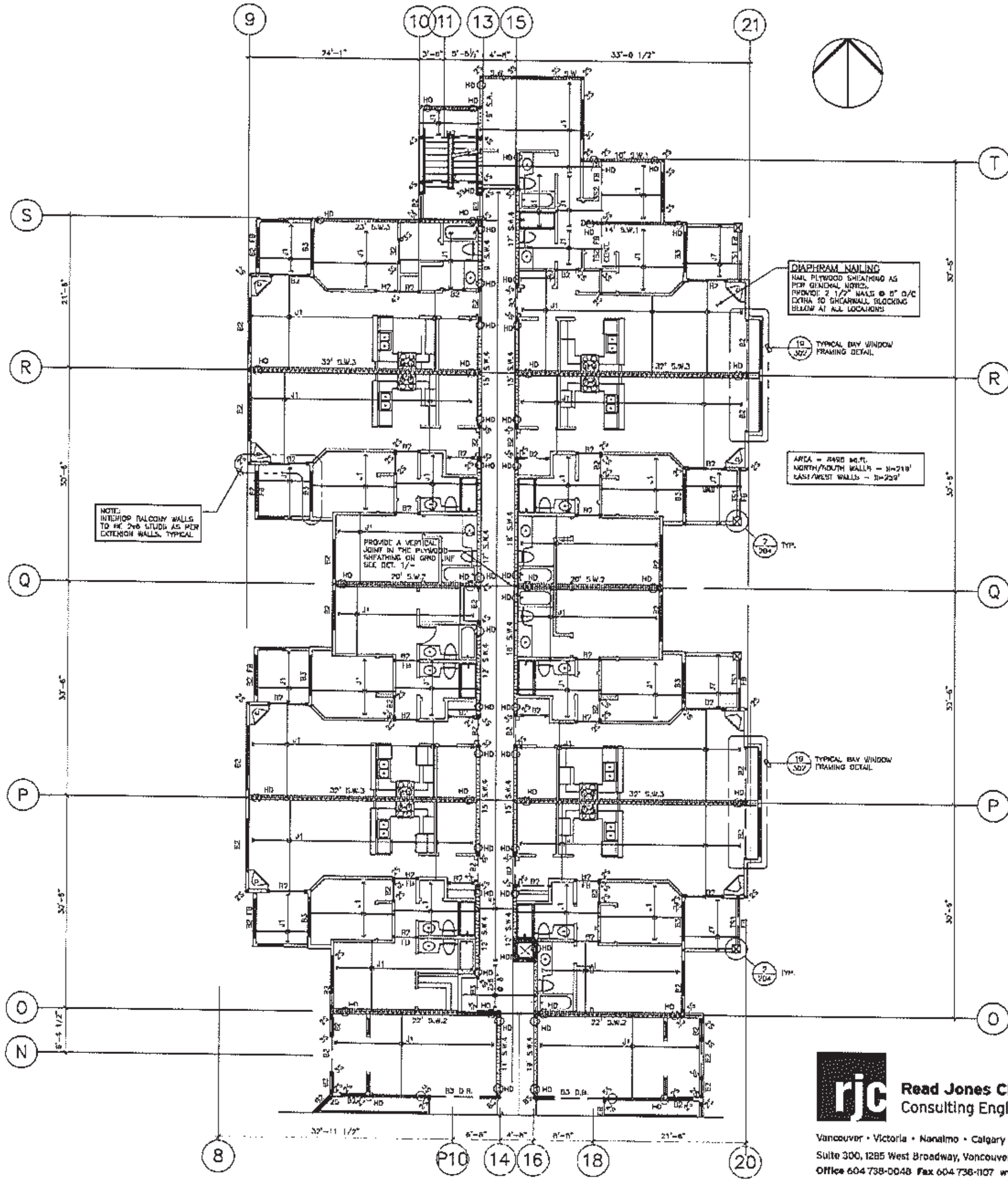
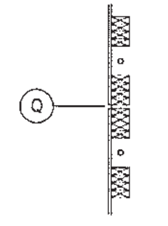
As noted	June 30, 2009	1000793.0001	2006-6-S-102	.

Appendix A – 9





1 PLAN
1" = 1'-0"

BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TB1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TB2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TB3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GR-1 – 5 1/8 x 8 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM
		GR-2 – 5 1/8 x 10 1/2 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM

1. ▬ ▬ INDICATES BEAM. PROVIDE BEAM (TB1) (B2) OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL, U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS.

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2-2 x 10 JOISTS @ 16"
J4 – 2-2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

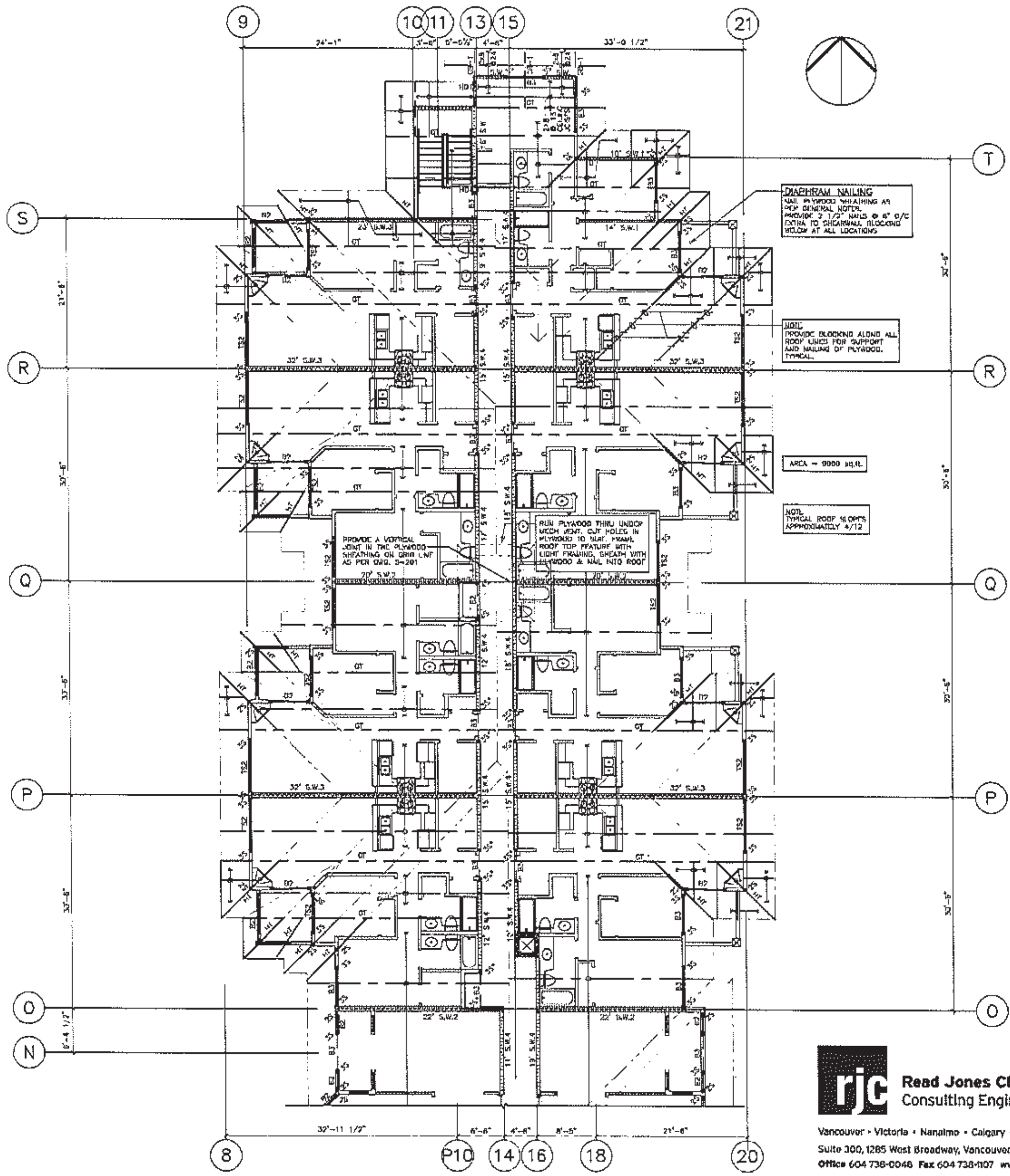
rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREYS
BCBC 2006

Level 2 to 6 Framing

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2006-6-S-201	

Appendix A – 10



BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TS1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TS2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TS3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GB-1 – 5 1/8 x 9 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM GB-2 – 5 1/8 x 10 1/2 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM

1. —— —— INDICATES BEAM. PROVIDE BEAM [TS1] [B1] OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL E/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS:
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102. NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY, INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2–2 x 10 JOISTS @ 16"
J4 – 2–2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO HOLD BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

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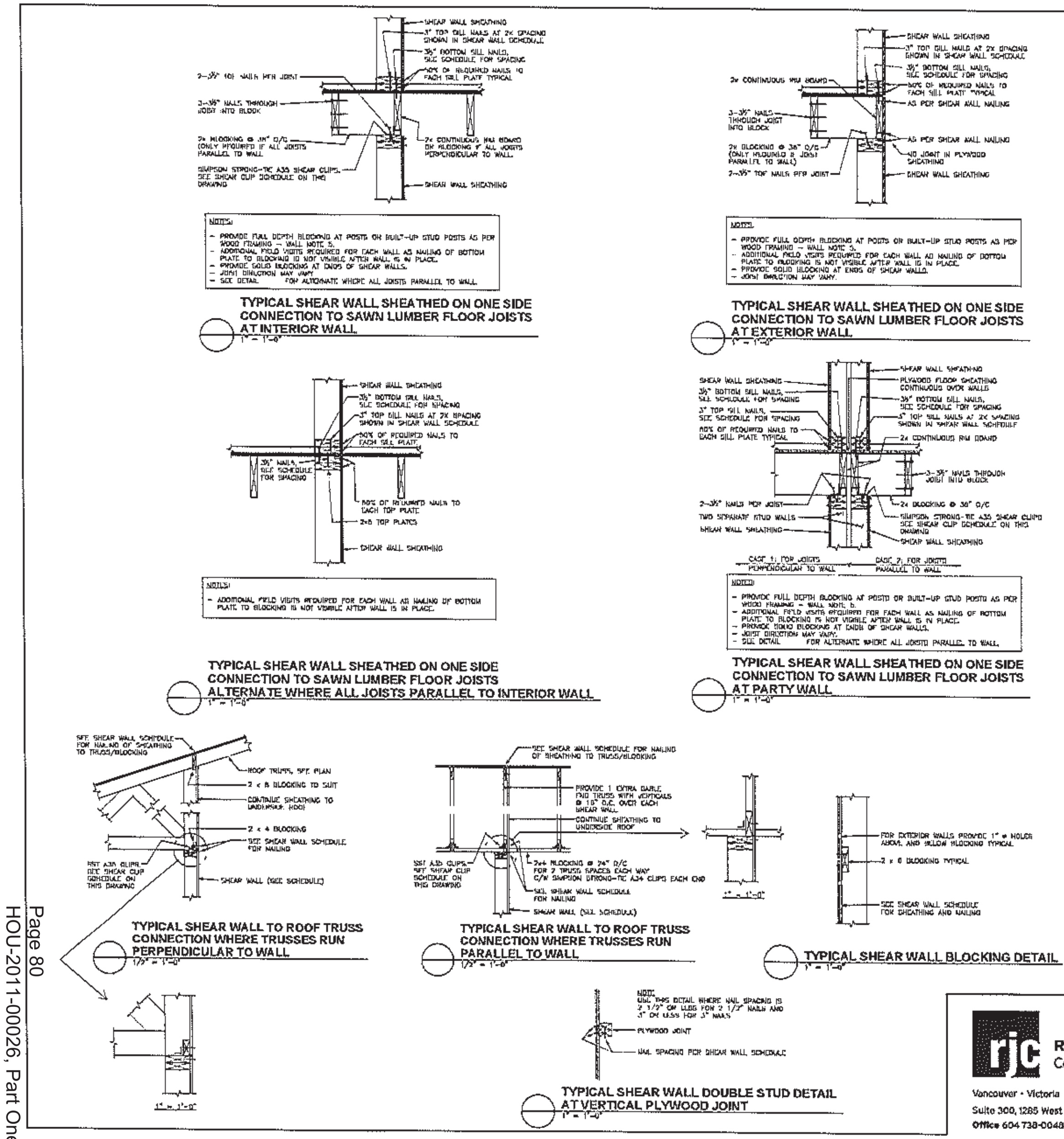
FORINTEK STUDY
6 STOREYS
BCBC 2006

Roof Plan

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2006	1000793.0001	2006-6-S-202	

Appendix A – 11

A-3) Design drawings of representative 4-storey building designed in accordance with 2010 NBCC

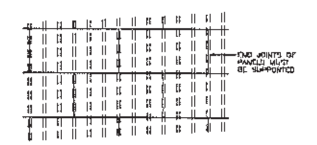


NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9 AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 15%) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE < 15%) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS. STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE

TOP OF FLOOR	2006 (4 STOREYS)
4TH FLOOR	A35 @ 24" O/C
3RD FLOOR	A35 @ 16" O/C
2ND FLOOR	A35 @ 12" O/C
1ST FLOOR	A35 @ 12" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   [— ALBERTA BUILDING CODE 2006 — PART 9]
   [— BRITISH COLUMBIA BUILDING CODE 2006 — PART 9]
   [— ONTARIO BUILDING CODE 2006 — PART 9]
   [— VANCOUVER BUILDING BYLAW — PART 9 (THE BUILDING CODE)]
   - CAN/CSA-O86 — ENGINEERING DESIGN IN WOOD
   - CSA O121 — DOUGLAS FIR PLYWOOD
   - CAN/CSA-LD 4000 PARALLAMS AND MICROLLAMS
   - CAN/CSA-O122 — STRUCTURAL GLUED-LAMINATED TIMBER
   - CAN O177 — QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   - CSA O437 — STRANDBOARD AND WAFERBOARD
   - CSA B111 — WIRE NAILS, SPIKES AND STAPLES
   - CAN/CSA-G34 MISCELLANEOUS BOLTS AND SCREWS
   - CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC
   - "WOOD DESIGN MANUAL" — CANADIAN WOOD COUNCIL
   - "WOOD BUILDING TECHNOLOGY" — CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   A. FLOORS: — NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   B. WALLS: — NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. — NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   C. OVERALL: — BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE D. FIR NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE D. FIR # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE. ALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC, COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.6 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION

rjc Read Jones Christoffersen Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREYS
BCBC 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2010-4-S-101	

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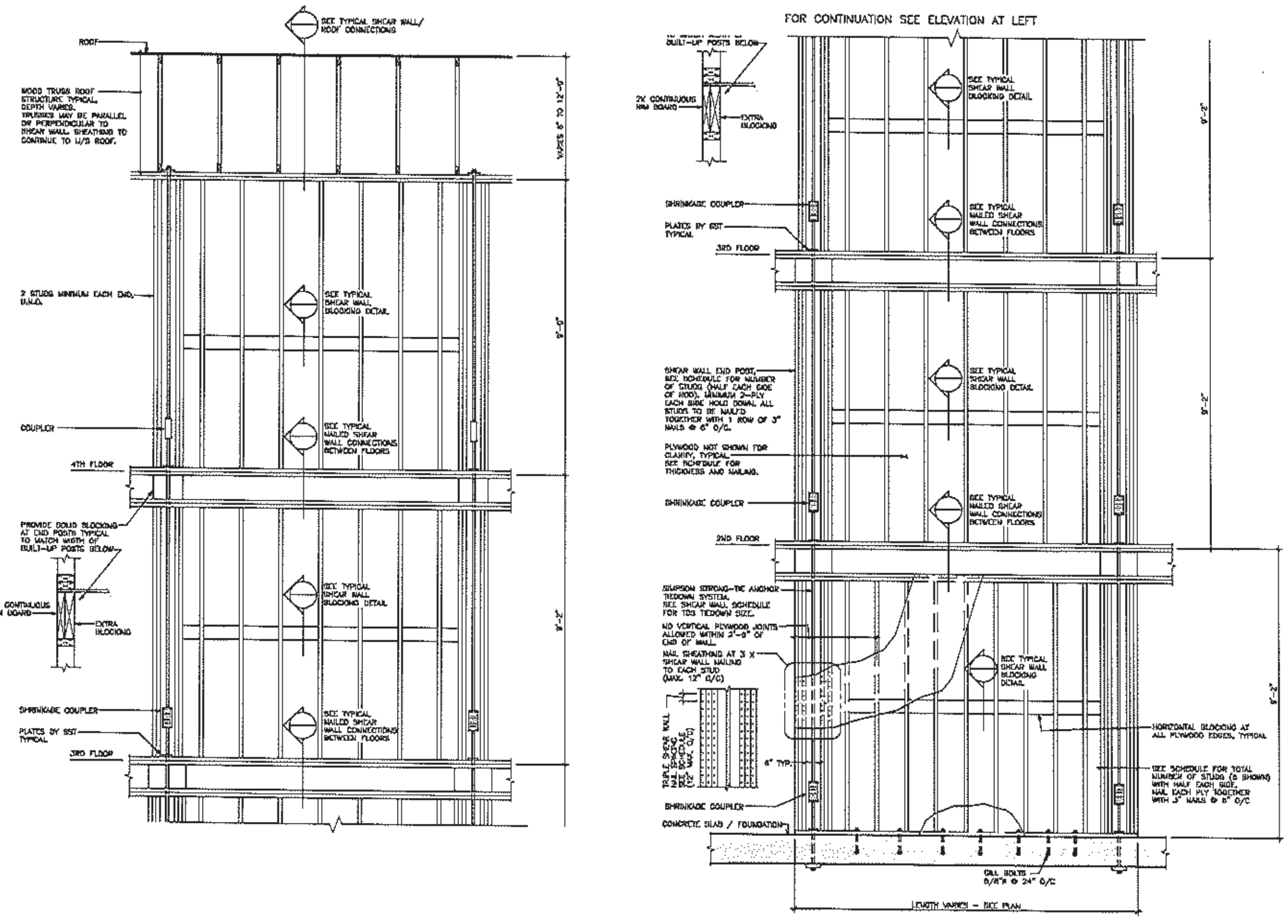

4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0" (TO BE USED AS A GUIDE ONLY)

Shear Wall Schedule - 4 Story Building 2010 BCBC				
	SW1	SW2	SW3	SW4
Level 4				
Hold Down	SR5	SR5	SR5	SR5
Posts	4-2x4	4-2x4	4-2x4	4-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	6"	6"	6"	6"
Level 3				
Hold Down	SR7	SR5	SR5	SR5
Posts	4-2x4	4-2x4	4-2x4	4-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	6"	4"	6"	6"
Level 2				
Hold Down	SR8	SR7	SR7[1]	SR7[1]
Posts	8-2x4	6-2x4	8-2x4	6-2x4
Sheathing	3/8	3/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"
Level 1				
Hold Down	SR9	SR7	SR7	SR7
Posts	8-2x4	6-2x4	8-2x4	8-2x4
Sheathing	3/8	4/8	3/8	3/8
Nail Length	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level

Note 1 - Indicates difference between 2006 BCBC and 2010 BCBC

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Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
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FORINTEK STUDY
4 STOREYS
BCBC 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2010-4-S-102	.

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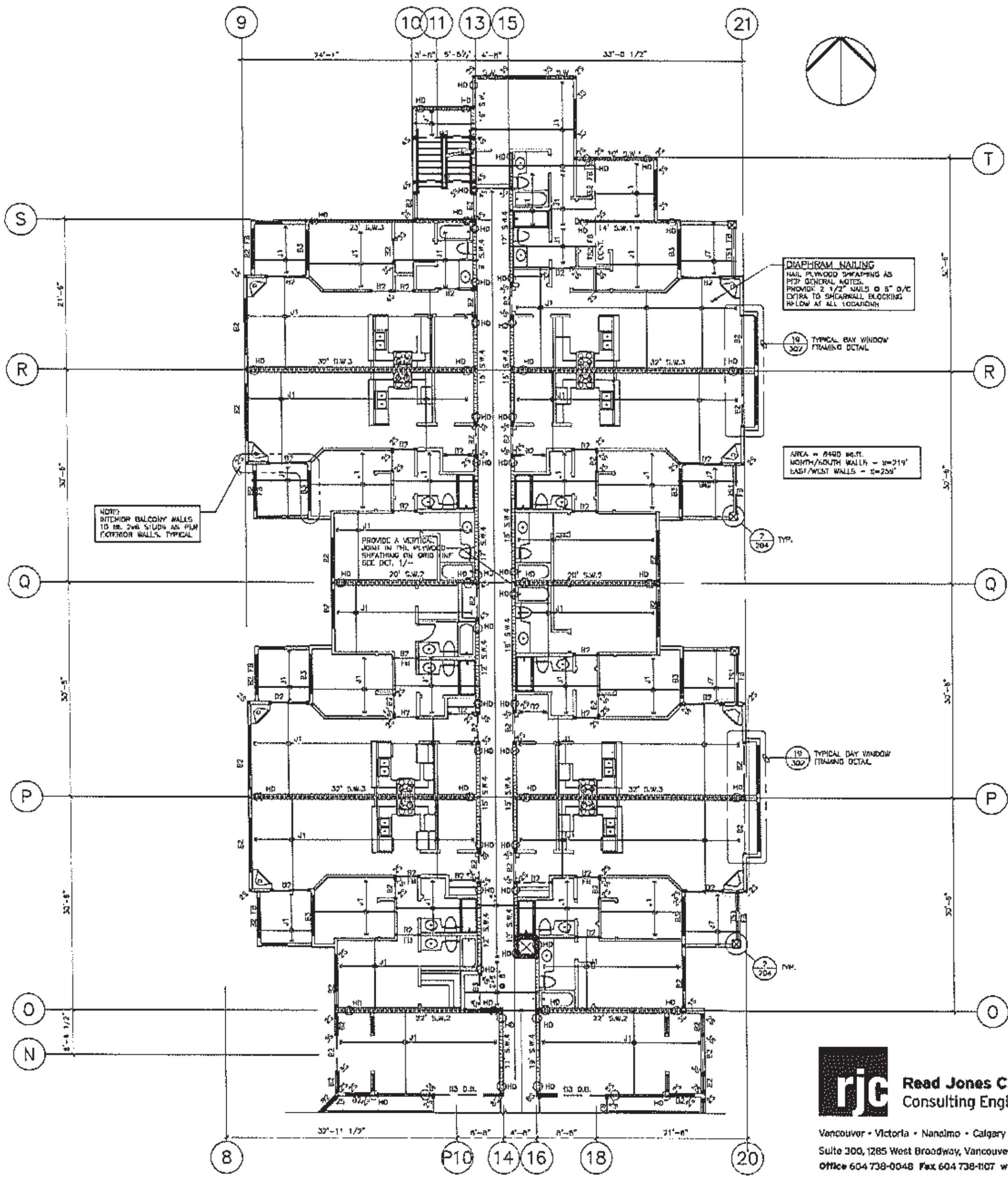

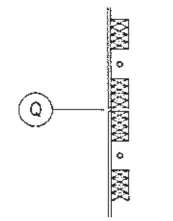

1 PLAN
1" = 1'-0"

BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TS1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TS2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TS3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GB–1 – 5⅛ x 9 SPRUCE–PINE 20f–Ex EXTERIOR GRADE GLULAM GB–2 – 5⅛ x 10½ SPRUCE–PINE 20f–Ex EXTERIOR GRADE GLULAM

1. INDICATES BEAM. PROVIDE BEAM [TS1] (HL) OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2–PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS:
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL, U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 4 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD–DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD–DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104
9. SEE ALSO REQUIREMENTS ON DRAWING S–102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING – 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2–2 x 10 JOISTS @ 16"
J4 – 2–2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
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FORINTEK STUDY
4 STOREYS
BCBC 2010

Level 2 to 4 Framing

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2010-4-S-201	.

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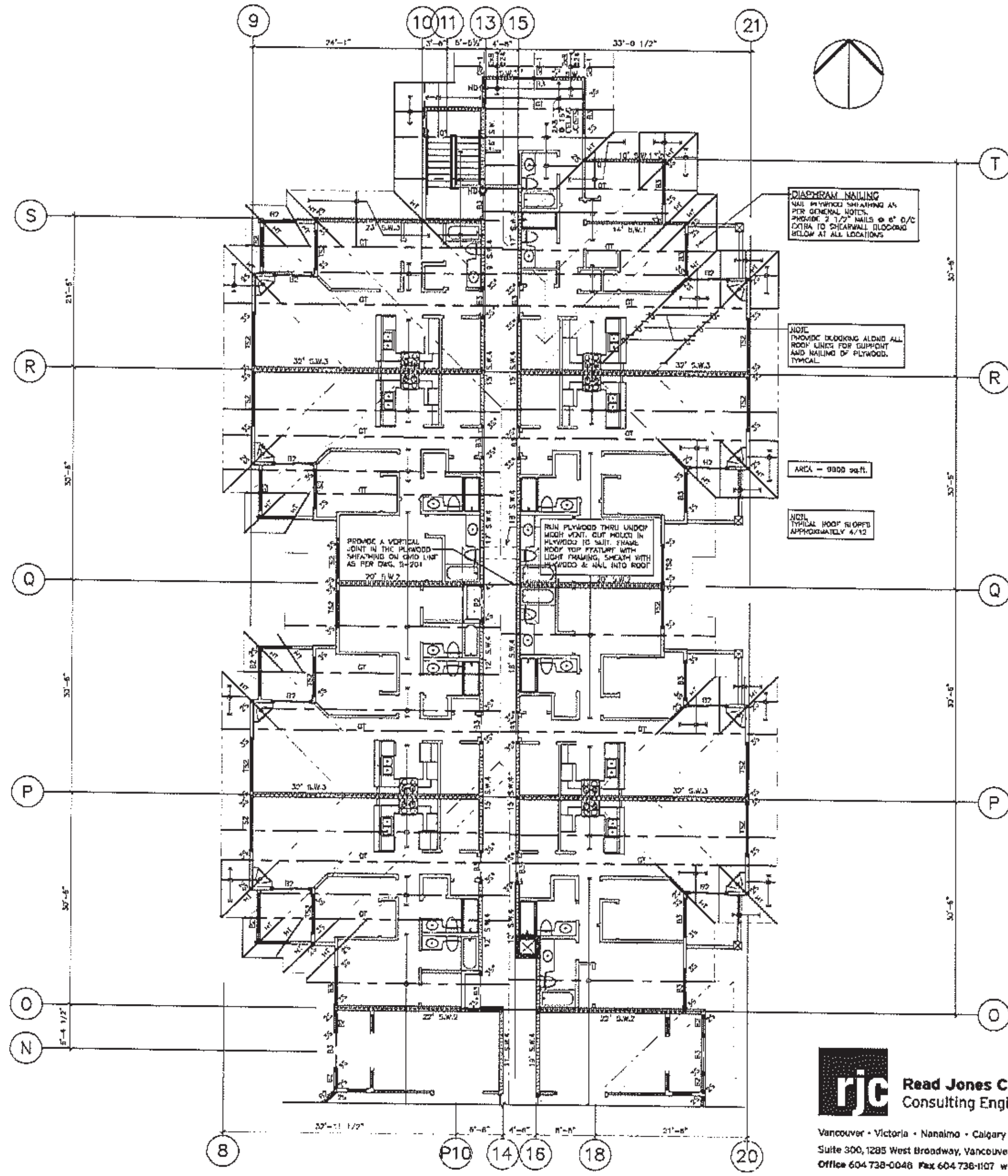


BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TB1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TB2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TB3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GB-1 – 5 1/8 x 9 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM GB-2 – 5 1/8 x 10 1/2 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM

1. ——— INDICATES BEAM. PROVIDE BEAM (TB1) (B2) OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS:
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102. NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2-2 x 10 JOISTS @ 16"
J4 – 2-2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 6 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

rjc Read Jones Christoffersen Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

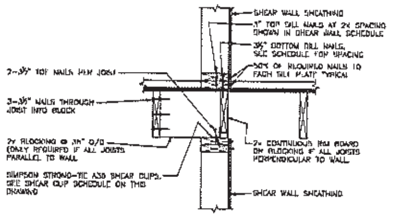
FORINTEK STUDY
4 STOREYS
BCBC 2010

Roof Plan

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2010-4-S-202	

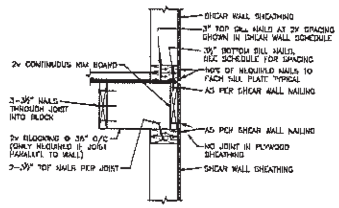
Appendix A – 16

A-4) Design drawings of representative 6-storey building designed in accordance with 2010 NBCC



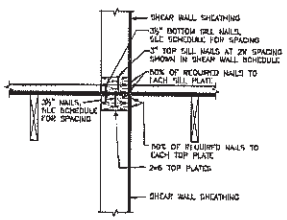
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 6.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



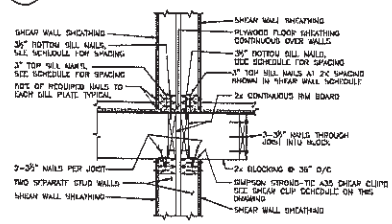
NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 6.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL
1" = 1'-0"



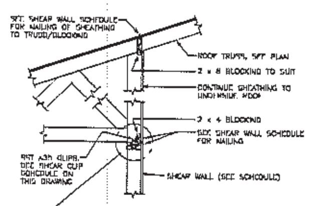
NOTES:
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.

TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS ALTERNATE WHERE ALL JOISTS PARALLEL TO INTERIOR WALL
1" = 1'-0"

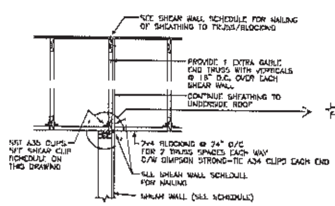


NOTES:
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 6.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

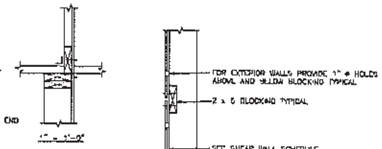
TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT PARTY WALL
1" = 1'-0"



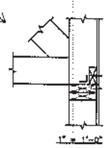
TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL
1/2" = 1'-0"

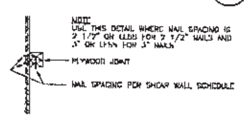


TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL
1/2" = 1'-0"



TYPICAL SHEAR WALL BLOCKING DETAIL
1" = 1'-0"





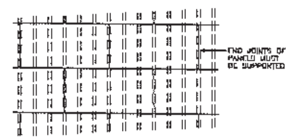
TYPICAL SHEAR WALL DOUBLE STUD DETAIL AT VERTICAL PLYWOOD JOINT
1" = 1'-0"

NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 15%) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE ≤ 15%) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS, STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE

TOP OF FLOOR	2006 (6 STOREYS)
6TH FLOOR	A35 @ 24" O/C
5TH FLOOR	A35 @ 18" O/C
4TH FLOOR	A35 @ 17" O/C
3RD FLOOR	A35 @ 17" O/C
2ND FLOOR	A35 @ 8" O/C
1ST FLOOR	A35 @ 8" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   [– ALBERTA BUILDING CODE 2006 – PART 9]
   [– BRITISH COLUMBIA BUILDING CODE 2006 – PART 9]
   [– ONTARIO BUILDING CODE 2006 – PART 9]
   [– VANCOUVER BUILDING BYLAW – PART 9 (THE BUILDING CODE)]
   – CAN/CSA-O86 – ENGINEERING DESIGN IN WOOD
   – CSA O121 – DOUGLAS FIR PLYWOOD
   – CAN/CSA-LD 4000 PARALLAMS AND MICROLLAMS
   – CAN/CSA-O122 – STRUCTURAL GLUED-LAMINATED TIMBER
   – CAN O177 – QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   – CSA O437 – STRANDBOARD AND WAFERBOARD
   – CSA B111 – WIRE NAILS, SPIKES AND STAPLES
   – CAN/CSA-B34 MISCELLANEOUS BOLTS AND SCREWS
   – CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC
   – "WOOD DESIGN MANUAL" – CANADIAN WOOD COUNCIL
   – "WOOD BUILDING TECHNOLOGY" – CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   A. FLOORS – NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   B. WALLS – NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. – NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   C. OVERALL – BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE D. FIR NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE D. FIR # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ('S4S').
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.8 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREYS
BCBC 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2010-6-S-101	

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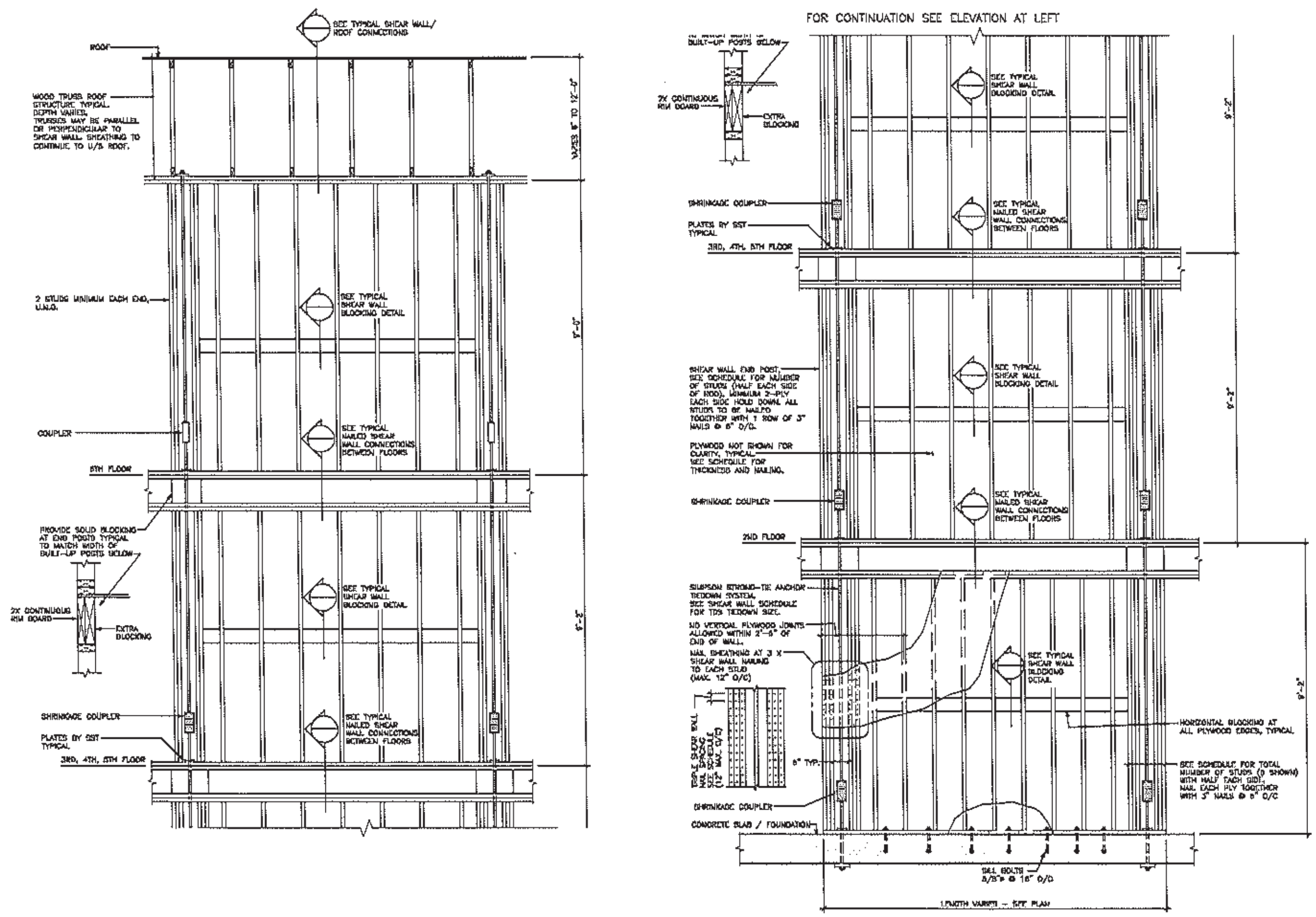

4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0"
(TO BE USED AS A GUIDE ONLY)

Shear Wall Schedule - 6 Story Building 2010 BCBC				
	SW1	SW2	SW3	SW4
Level 6				
Hold Down	SR6	SR5	SR5	SR5
Posts	6-2x4	4-2x4	4-2x4	4-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	6"	6"	6"	6"
Level 5				
Hold Down	SR9	SR6	SR5	SR6
Posts	6-2x4	4-2x4	4-2x4	4-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	6"	4"	6"	4"
Level 4				
Hold Down	SR9	SR7[1]	SR5	SR7[1]
Posts	6-2x4	6-2x4	6-2x4	6-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	2.5	2.5	2.5
Nail Spacing	4"	3"	4"	4"
Level 3				
Hold Down	SR10	SR7	SR7	SR7
Posts	8-2x4	8-2x4	6-2x4	8-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	3	2.5	2.5
Nail Spacing	4"	3"	4"	3"
Level 2				
Hold Down	SR10	SR9	SR7	SR9
Posts	8-2x4	8-2x4	8-2x4	8-2x4
Sheathing	4/8	4/8	4/8	4/8
Nail L	2.5	3	2.5	2.5
Nail Spacing	3"	3"	3"	2.5"
Level 1				
Hold Down	SR10	HSR9[1]	SR9	HSR9[1]
Posts	8-2x4	8-2x6	8-2x4	8-2x6
Sheathing	4/8	4/8	4/8	1/2
Nail L	2.5	3	2.5	2.5
Nail Spacing	3"	2.5"	3"	2.5"

Hold Down – ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level

Note 1 – Indicates difference between 2006 BCBC and 2010 BCBC

Read Jones Christoffersen
Consulting Engineers

Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREYS
BCBC 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	1000793.0001	2010-6-S-102	.

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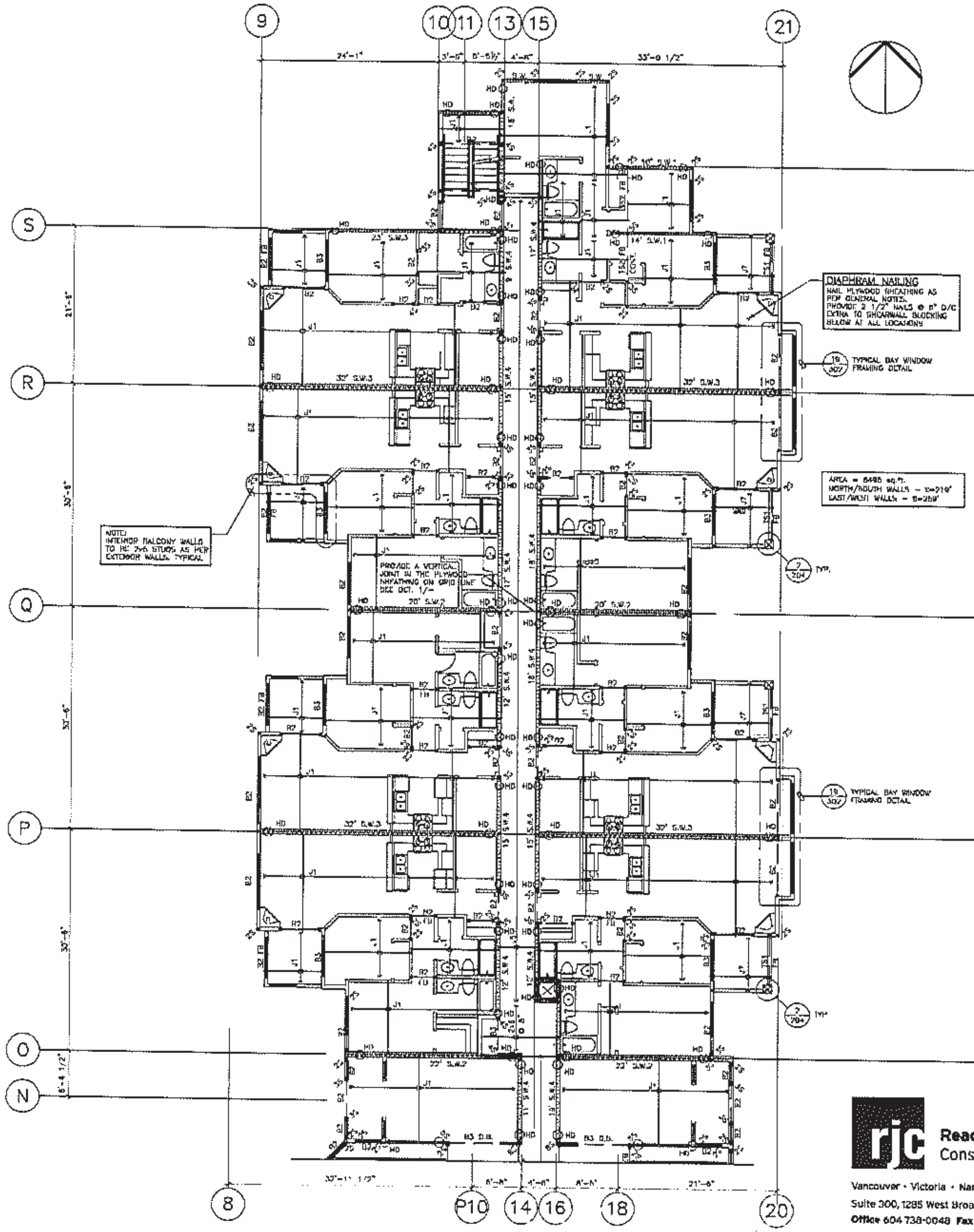

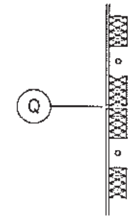

1 PLAN
1" = 1'-0"

BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TB1 - 3 1/2" x 7 1/4" DP.	PB1 - 3 1/2" x 9 1/2" DP.	B2 - 2 - 2 x 10
TB2 - 3 1/2" x 9 1/2" DP.	PB2 - 3 1/2" x 11 7/8" DP.	B3 - 3 - 2 x 10
TB3 - 3 1/2" x 11 7/8" DP.	PB3 - 3 1/2" x 14" DP.	B4 - 4 - 2 x 10
	PB4 - 5 1/4" x 9 1/2" DP.	B2A - 2 - 2 x 12
	PB5 - 5 1/4" x 11 7/8" DP.	B3A - 3 - 2 x 12
	PB6 - 5 1/4" x 14" DP.	B4A - 4 - 2 x 12
	PB7 - 5 1/4" x 18" DP.	GB-1 - 5 1/8 x 9 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM
		GB-2 - 5 1/8 x 10 1/2 SPRUCE-PINE 20f-E EXTERIOR GRADE GLULAM

1. —— INDICATES BEAM. PROVIDE BEAM (TB1) (B1) OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS - ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL U.N.O.
   CORRIDOR WALLS - ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS - ONE LAYER TO ONE SIDE - SEE PLAN
   EXTERIOR WALLS - ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 U.N.O.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 - 2 x 10 JOISTS @ 16"
J2 - 2 x 10 JOISTS @ 12"
J3 - 2-2 x 10 JOISTS @ 16"
J4 - 2-2 x 10 JOISTS @ 12"
J5 - 2 x 8 JOISTS @ 16"
J6 - 2 x 8 JOISTS @ 12"
J7 - 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

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FORINTEK STUDY
6 STOREYS
BCBC 2010

Level 2 to 6 Framing

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2010-6-S-201	

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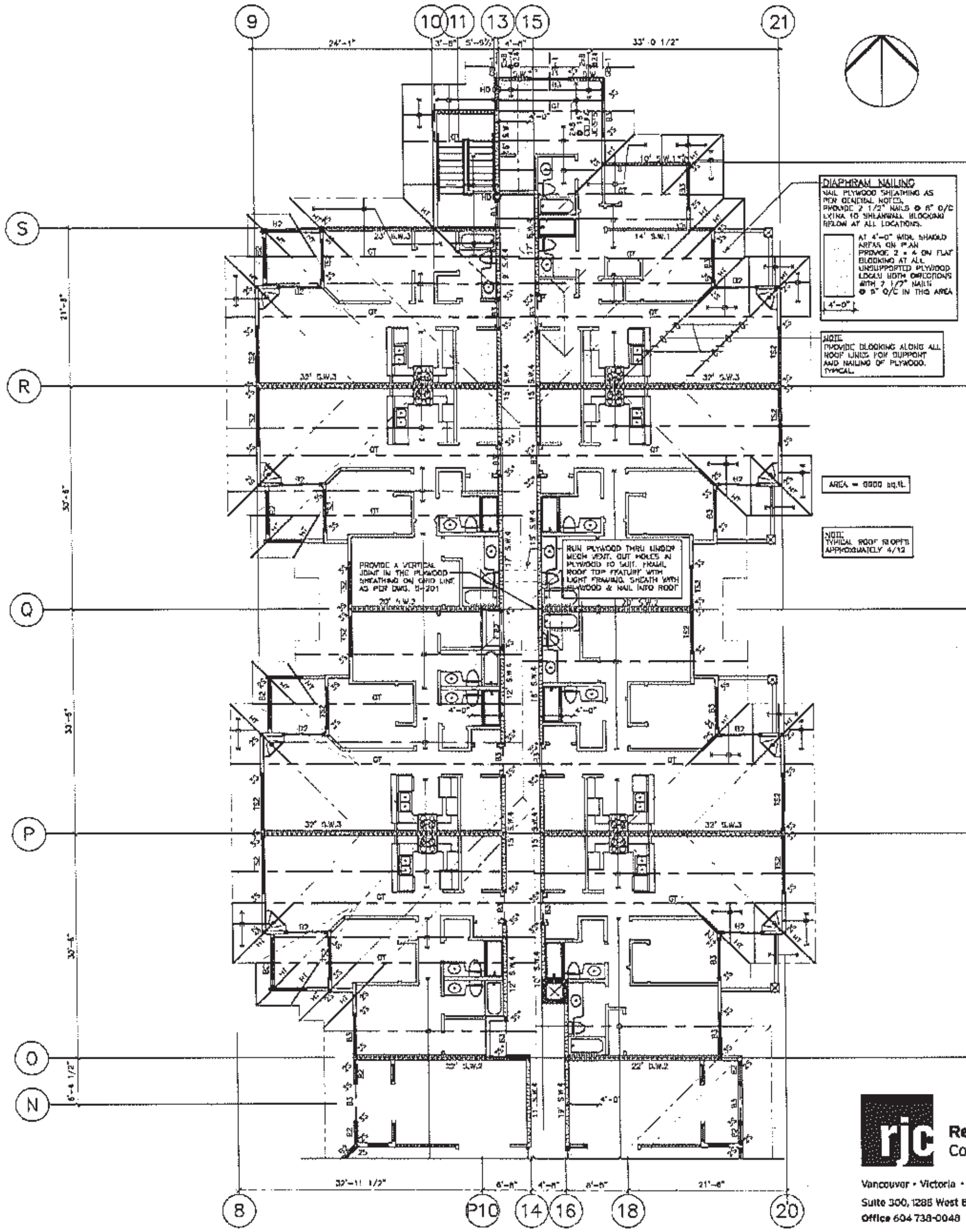


BEAM SCHEDULE

TIMBERSTRAND BEAMS	PARALLAM BEAMS	BUILT-UP BEAMS FROM SAWN TIMBER (KILN DRIED) & GLULAM BEAMS
TB1 – 3 1/2" x 7 1/4" DP.	PB1 – 3 1/2" x 9 1/2" DP.	B2 – 2 – 2 x 10
TB2 – 3 1/2" x 9 1/2" DP.	PB2 – 3 1/2" x 11 7/8" DP.	B3 – 3 – 2 x 10
TB3 – 3 1/2" x 11 7/8" DP.	PB3 – 3 1/2" x 14" DP.	B4 – 4 – 2 x 10
	PB4 – 5 1/4" x 9 1/2" DP.	B2A – 2 – 2 x 12
	PB5 – 5 1/4" x 11 7/8" DP.	B3A – 3 – 2 x 12
	PB6 – 5 1/4" x 14" DP.	B4A – 4 – 2 x 12
	PB7 – 5 1/4" x 16" DP.	GB-1 – 5 1/8 x 9 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM
		GB-2 – 5 1/8 x 10 1/2 SPRUCE-PINE 20f-Ex EXTERIOR GRADE GLULAM

1. ——— INDICATES BEAM. PROVIDE BEAM (TB1) (B1) OVER ALL DOORS AND WINDOWS IN LOAD BEARING WALLS, TYPICAL U.N.O. PROVIDE BUILT-UP STUD POST OF 2 STUDS MINIMUM EACH END OF BEAMS U.N.O. ON PLAN.
2. ALL BEAMS ARE "DROPPED" WITH JOISTS OVER AT EXTERIOR WALLS, INTERIOR WALLS, AND INTERIOR DOORS, UNLESS NOTED OTHERWISE. ALL OTHER INTERIOR BEAMS SHALL BE FLUSH, U.N.O. "DB" MEANS DROPPED BEAM, AND "FB" MEANS FLUSH BEAM.
3. NOT ALL BEAMS ARE USED ON PLAN.
4. SEE DETAIL C/103 FOR TYPICAL EXTERIOR WALL HEADER DETAIL.
5. PROVIDE 2-PLY MEMBER MINIMUM AROUND BALCONY PERIMETER U.N.O.

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL.
2. SHEATH AS FOLLOWS U.N.O.
   PARTY WALLS – ONE LAYER TO ONE 2 x 4 STUD WALL ON SUITE SIDE OF WALL U.N.O.
   CORRIDOR WALLS – ONE LAYER TO CORRIDOR SIDE
   INTERIOR WALLS – ONE LAYER TO ONE SIDE – SEE PLAN
   EXTERIOR WALLS – ONE LAYER TO EXTERIOR SIDE.
3. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
4. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102. NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
5. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
6. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
7. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.
8. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S104.
9. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
10. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

JOIST SCHEDULE

J1 – 2 x 10 JOISTS @ 16"
J2 – 2 x 10 JOISTS @ 12"
J3 – 2-2 x 10 JOISTS @ 16"
J4 – 2-2 x 10 JOISTS @ 12"
J5 – 2 x 8 JOISTS @ 16"
J6 – 2 x 8 JOISTS @ 12"
J7 – 2 x 8 JOISTS @ 16"

NOTES:
1. PROVIDE 2 x 10 BLOCKING PANELS BETWEEN JOISTS @ ALL INTERMEDIATE AND END BEARING POINTS.
2. PROVIDE 2 x 4 BLOCKS AS REQUIRED TO SOLID BLOCK POST LOADS FROM ABOVE TO BEARING PLATE BELOW.
3. USE TOP FLANGE HANGERS FOR ALL FLUSH FRAMED CONNECTIONS.

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

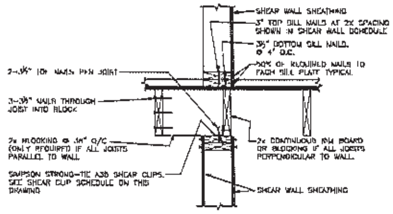
FORINTEK STUDY
6 STOREYS
BCBC 2010

Roof Plan

Scale	Date	Project No.	Sketch Number	Rev.
1/16" = 1'-0"	June 30, 2009	1000793.0001	2010-6-S-202	.

Appendix A – 21

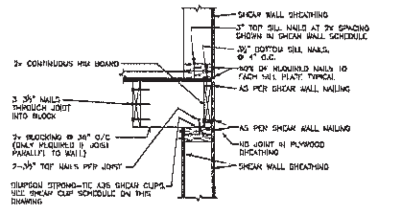
A-5) Design drawings of NEESWood Capstone 4-storey building designed in accordance with 2010 NBCC



NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

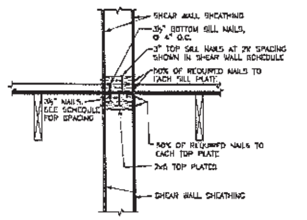
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

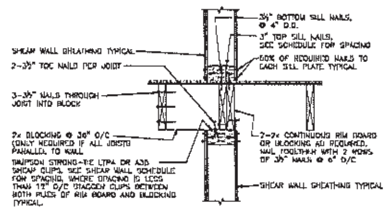
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL
1" = 1'-0"



NOTES:

- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.

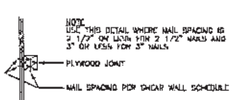
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS ALTERNATE WHERE ALL JOISTS PARALLEL TO INTERIOR WALL
1" = 1'-0"



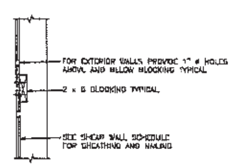
NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING – WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



TYPICAL SHEAR WALL DOUBLE STUD DETAIL AT VERTICAL PLYWOOD JOINT
1" = 1'-0"



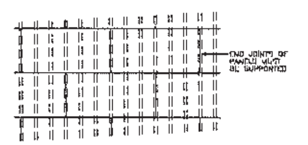
TYPICAL SHEAR WALL BLOCKING DETAIL
1" = 1'-0"

NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 15%) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE < 15%) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS, STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE 2006 BCBC

TOP OF FLOOR	WALL 1,3,6	WALL 2,4,5
4TH FLOOR	A35 @ 16" O/C	A35 @ 24" O/C
3RD FLOOR	A35 @ 8" O/C	A35 @ 12" O/C
2ND FLOOR	A35 @ 8" O/C	A35 @ 8" O/C
1ST FLOOR	A35 @ 8" O/C	A35 @ 8" O/C

SHEAR CLIP SCHEDULE 2010 BCBC

TOP OF FLOOR	WALL 1,3,6	WALL 2,4,5
4TH FLOOR	A35 @ 12" O/C	A35 @ 24" O/C
3RD FLOOR	A35 @ 8" O/C	A35 @ 12" O/C
2ND FLOOR	A35 @ 8" O/C	A35 @ 8" O/C
1ST FLOOR	A35 @ 8" O/C	A35 @ 8" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   - [– ALBERTA BUILDING CODE 2006 – PART 9]
   - [– BRITISH COLUMBIA BUILDING CODE 2006 – PART 9]
   - [– ONTARIO BUILDING CODE 2006 – PART 9]
   - [– VANCOUVER BUILDING BYLAW – PART 9 (THE BUILDING CODE)]
   - CAN/CSA-O86 – ENGINEERING DESIGN IN WOOD
   - CSA O121 – DOUGLAS FIR PLYWOOD
   - CAN/CSA-LO 4000 PARALLAMS AND MICROLLAMS
   - CAN/CSA-O122 – STRUCTURAL GLUED-LAMINATED TIMBER
   - CAN O177 – QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   - CSA O437 – STRANDBOARD AND WAFERBOARD
   - CSA B111 – WIRE NAILS, SPIKES AND STAPLES
   - CAN/CSA-B34 MISCELLANEOUS BOLTS AND SCREWS
   - CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC
   - "WOOD DESIGN MANUAL" – CANADIAN WOOD COUNCIL
   - "WOOD BUILDING TECHNOLOGY" – CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM, REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   - A. FLOORS – NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   - B. WALLS – NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. – NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   - C. OVERALL – BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE SPF NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE SPF # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.8 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.

Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1286 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	VAN.100793.0001	S-101	1

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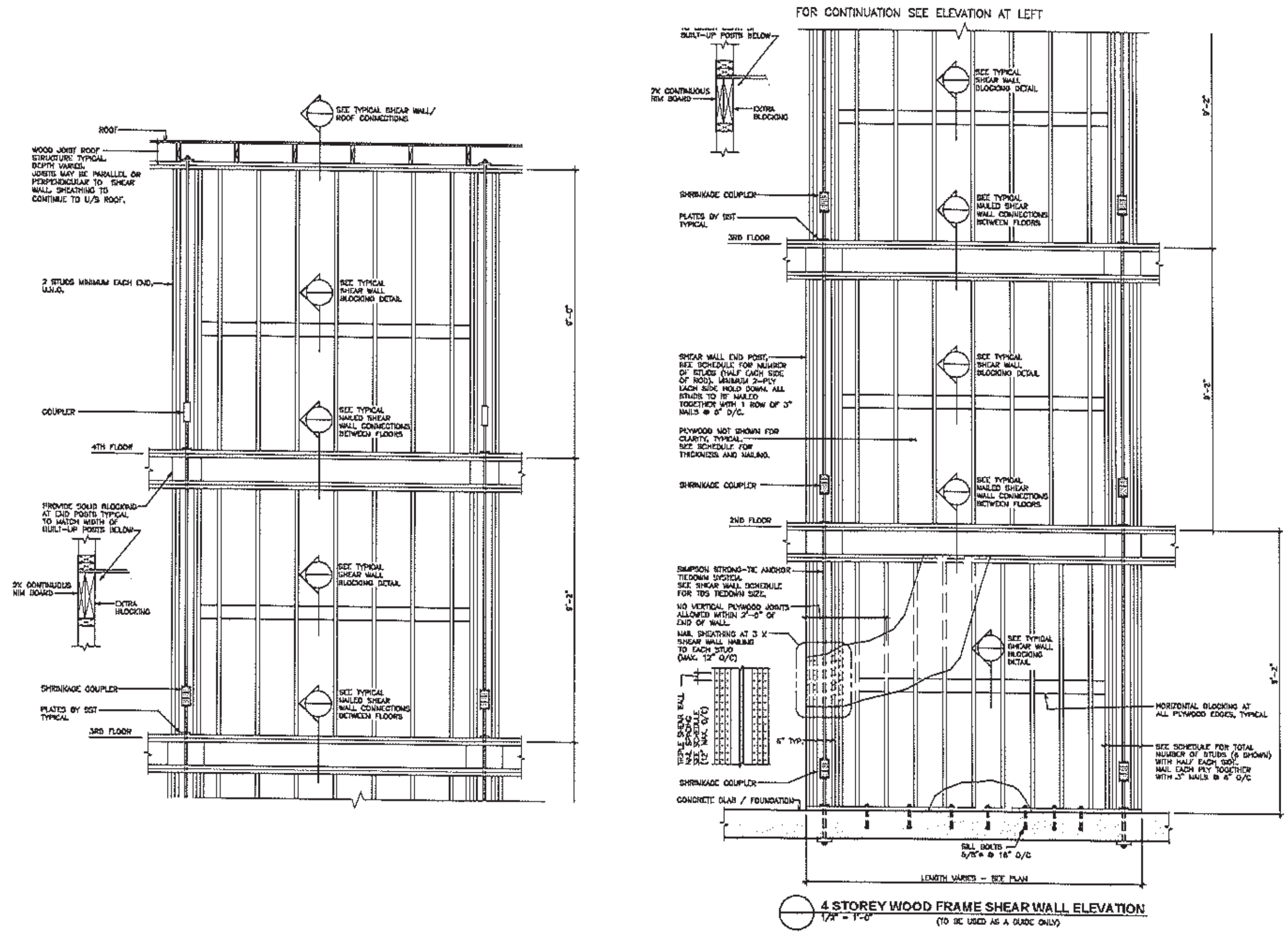
Shear Wall Requirements - 4 Story Building 2006 BCBC						
	SW1	SW2	SW3	SW4	SW5	SW6
Level 4						
Hold Down	SR5			SR5	SR5	SR5
Posts	4-2x6			4-2x6	4-2x6	4-2x4
Sheathing	1/2"			1/2"	1/2"	1/2"
Nail L	2.5			2.5	2.5	2.5
Nail Spacing	4"			6"	6"	4"
Level 3						
Hold Down	SR7	SR8	SR9	SR8	SR5	
Posts	4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	3"	3"	3"	4"	4"	
Level 2						
Hold Down	SR7	SR9	SR9	SR5	SR8	
Posts	4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	3	3	3	3	
Nail Spacing	2"	3"	2"	3"	3"	
Level 1						
Hold Down	HSR9	SR9	SR9	SR7	SR7	
Posts	6-2x6	6-2x6	6-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	3	3	3	3	
Nail Spacing	2"	3"	2"	3"	3"	

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level.

Shear Wall Requirements - 4 Story Building 2010 BCBC						
	SW1	SW2	SW3	SW4	SW5	SW6
Level 4						
Hold Down	SR5			SR5	SR5	SR5
Posts	4-2x6			4-2x6	4-2x6	4-2x4
Sheathing	1/2"			1/2"	1/2"	1/2"
Nail L	2.5			2.5	2.5	2.5
Nail Spacing	4"			6"	6"	4"
Level 3						
Hold Down	SR7	SR9	SR9	SR5	SR5	
Posts	4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	3"	3"	3"	4"	4"	
Level 2						
Hold Down	SR9	SR9	SR9	SR7	SR7	
Posts	4-2x6	4-2x6	4-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	3	3	3	3	
Nail Spacing	2"	3"	2"	3"	3"	
Level 1						
Hold Down	HSR9	SR9	SR9	SR7	SR7	
Posts	6-2x6	6-2x6	6-2x6	4-2x6	4-2x6	
Sheathing	1/2"	1/2"	1/2"	1/2"	1/2"	
Nail L	3	3	3	3	3	
Nail Spacing	2"	3"	2"	3"	3"	

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level.

Values shown in shading show the only difference between the 2006 BCBC and 2010 BCBC (which includes a 1.2 ed)



4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0"
(TO BE USED AS A GUIDE ONLY)

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	VAN.100793.0001	S-102	1

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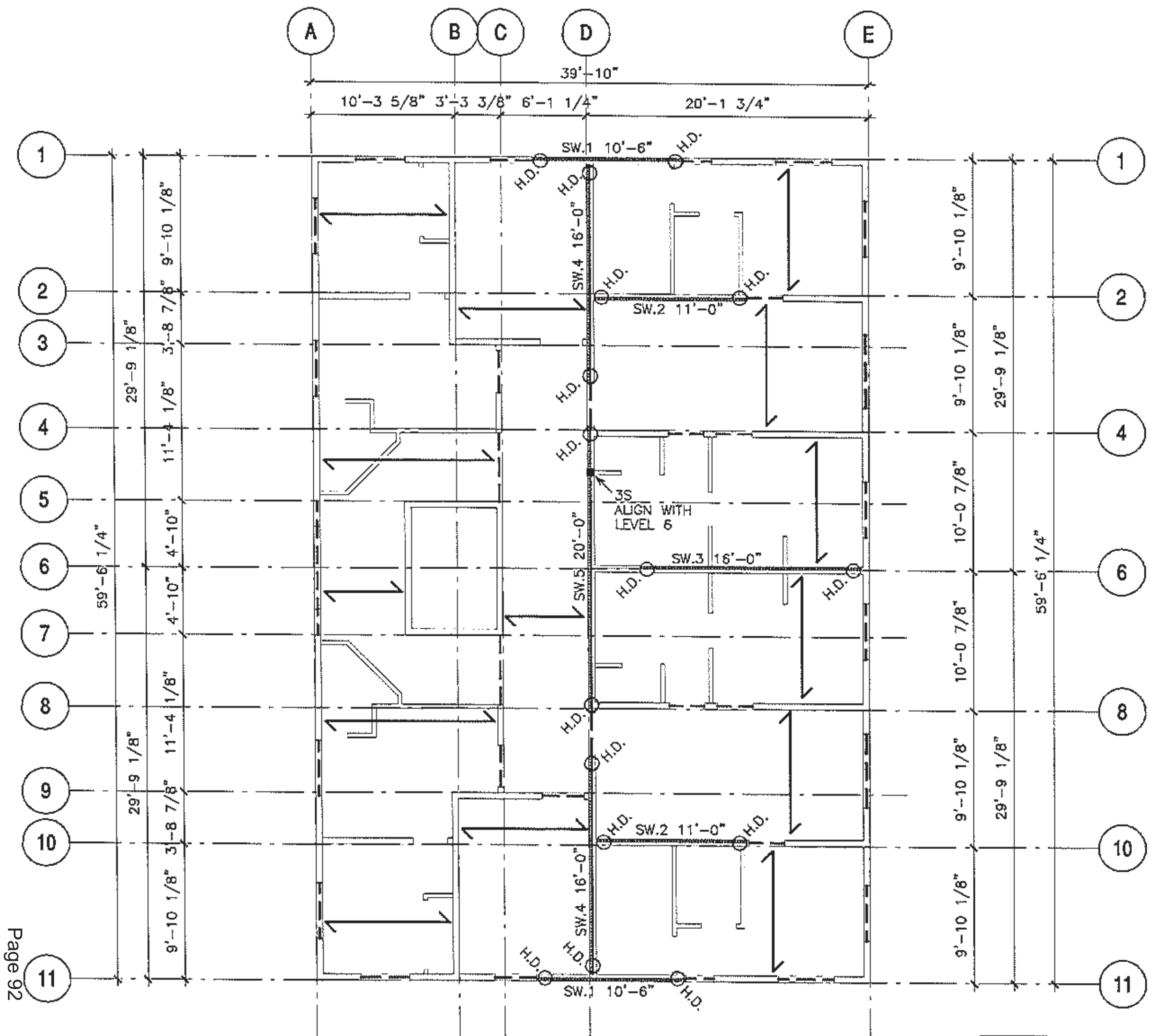

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: XXXXXXXXXXXXXXXXXXXXXXXX
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL. SHEATH EACH SIDE WHERE "S.W." IS SHOWN ON BOTH SIDES.
2. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
3. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 8 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S-102
8. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
9. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

LEGEND

- INDICATES JOIST DIRECTION
- INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

* – 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE. NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 – 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES. PROVIDE 3" NAILS @ 6" O.C. EXTRA TO SHEARWALL BLOCKING BELOW AT ALL LOCATIONS.

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
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Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

1st Floor Walls Showing 2nd Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	VAN.100793.0001	S-201	1

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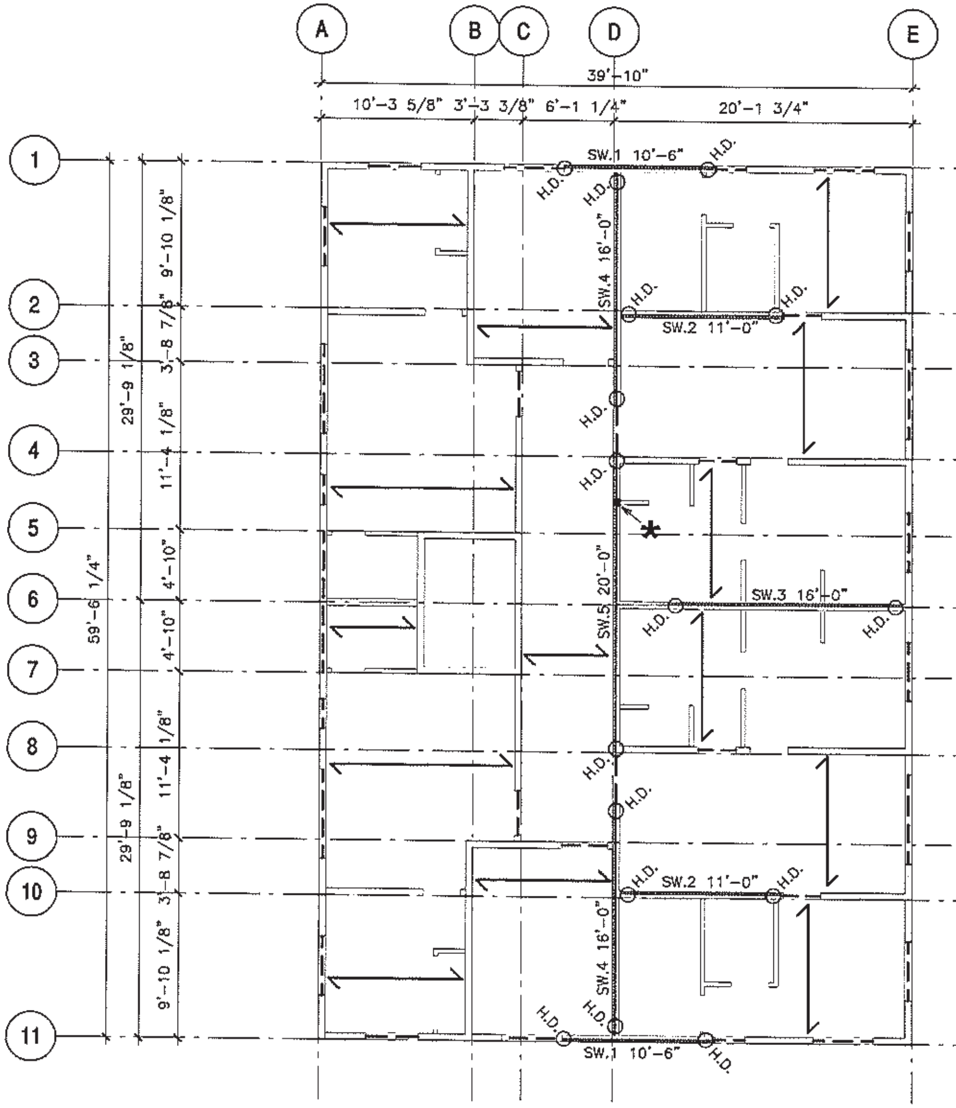

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: XXXXXXXXXXXXXXXXXXXXX
   S.W.— INDICATES PLYWOOD SHEATHED SIDE OF WALL. SHEATH EACH SIDE WHERE "S.W." IS SHOWN ON BOTH SIDES.
2. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
3. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S-102
8. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
9. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

LEGEND

- INDICATES JOIST DIRECTION
- INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

* – 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE. NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 – 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES. PROVIDE 3" NAILS @ 6" O.C. EXTRA TO SHEARWALL BLOCKING BELOW AT ALL LOCATIONS.

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

2nd Floor Walls Showing 3rd Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	VAN.100793.0001	S-202	1

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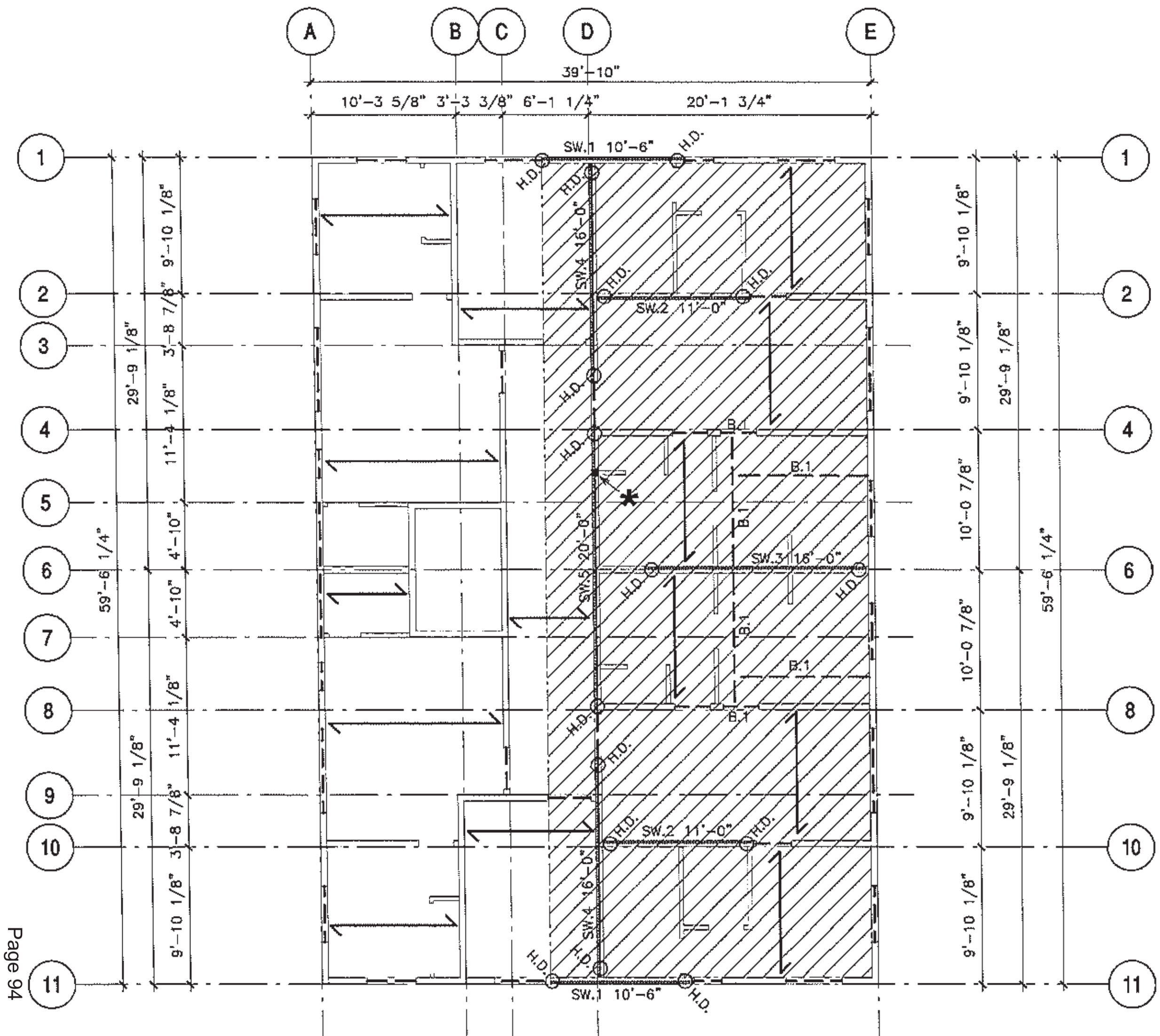

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: XXXXXXXXXXXXXXXXXXXXXX
   S.W.— INDICATES PLYWOOD SHEATHED SIDE OF WALL. SHEATH EACH SIDE WHERE "S.W." IS SHOWN ON BOTH SIDES.
2. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
3. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S-102
8. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
9. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

LEGEND

- INDICATES JOIST DIRECTION
- INDICATES LEAD BEARING WALL (2x6)

SW.X - INDICATES SHEARWALL

* - 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE.
NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 - 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES.

AT HATCHED AREA ON PLAN PROVIDE 2x4 BLOCKING ON FLAT AT ALL UNSUPPORTED PLYWOOD EDGES.
NAIL ALL PANEL PERIMETERS WITH:
- 3" NAILS @ 3" O.C. BCBC 2006
- 3" NAILS @ 2½" O.C. BCBC 2010

NAIL SHEATHING TO SHEARWALL BLOCKING BELOW WITH 3" NAILS @ 3" O.C.

rjc Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

3rd Floor Walls Showing 4th Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	VAN.100793.0001	S-203	1

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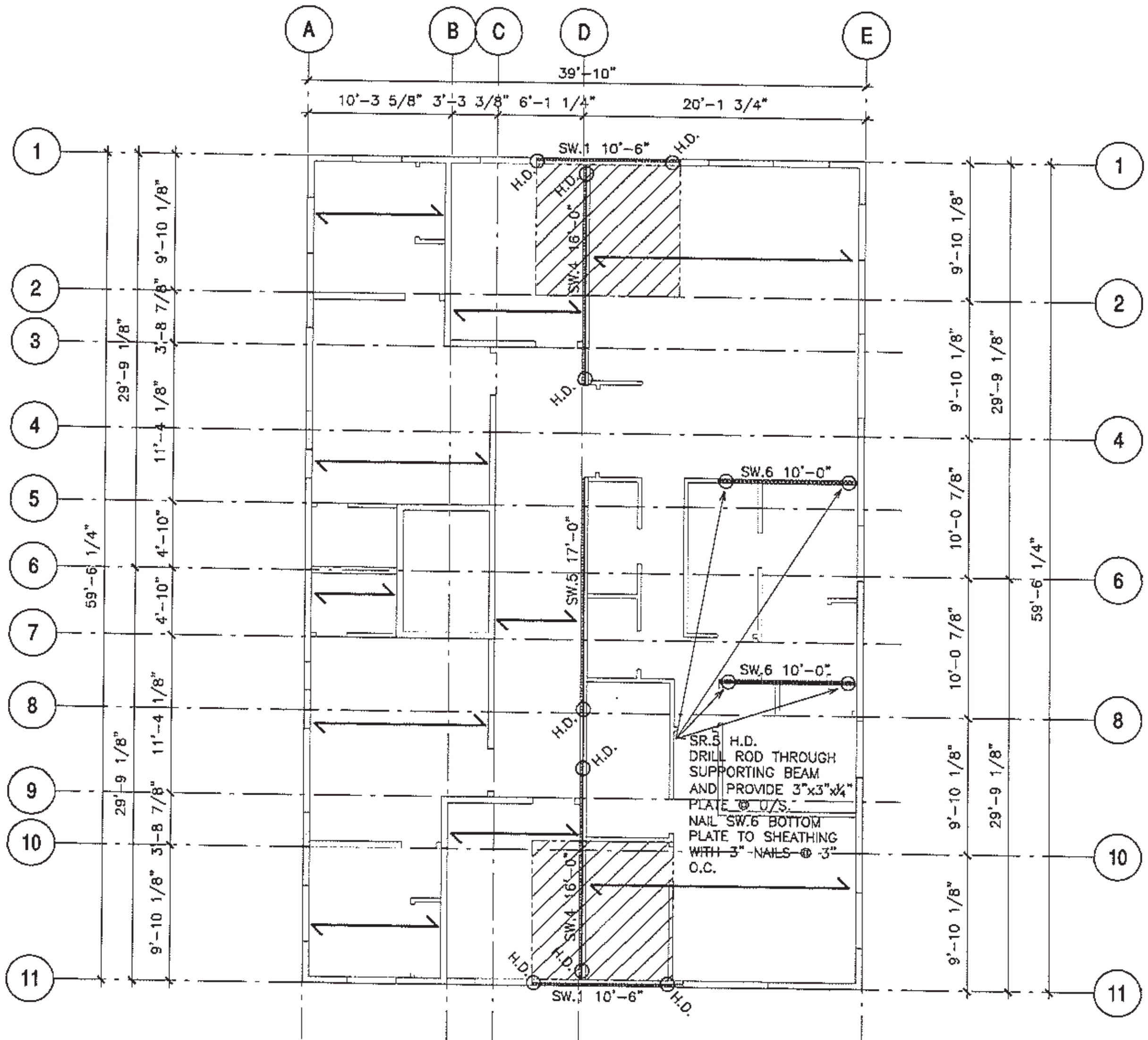

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: XXXXXXXXXXXXXXXXXXXXXXX
   S.W. — INDICATES PLYWOOD SHEATHED SIDE OF WALL. SHEATH EACH SIDE WHERE "S.W." IS SHOWN ON BOTH SIDES.
2. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
3. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S-102
8. SEE ALSO REQUIRMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
9. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

LEGEND

- INDICATES JOIST DIRECTION

- INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

* – 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE. NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 – 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES. PROVIDE 3" NAILS @ 4" O.C. EXTRA TO THE TOP OF ALL SHEARWALL BLOCKING BELOW.

AT HATCHED AREA ON PLAN PROVIDE 2x4 BLOCKING ON FLAT AT ALL UNSUPPORTED PLYWOOD EDGES. NAIL ALL PANEL PERIMETERS WITH:
- 3" NAILS @ 4" O.C. BCBC 2006
- 3" NAILS @ 2½" O.C. BCBC 2010

NAIL SHEATHING TO SHEARWALL BLOCKING BELOW WITH 3" NAILS @ 4" O.C.

Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
4 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

4th Floor Walls Showing Roof Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	VAN.100793.0001	S-204	1

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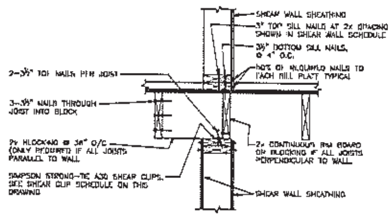
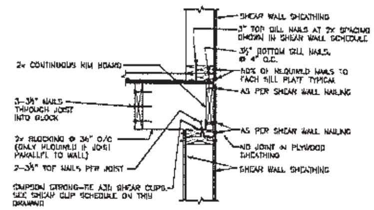
A-6) Design drawings of NEESWood Capstone 6-storey building designed in accordance with 2010 NBCC



NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

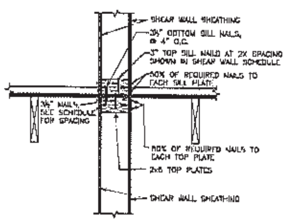
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

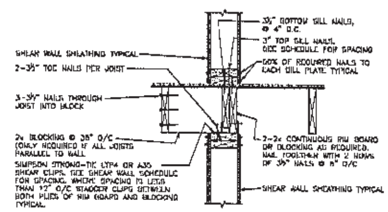
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL
1" = 1'-0"



NOTES:

- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.

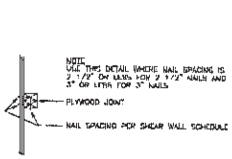
TYPICAL SHEAR WALL SHEATHED ON TWO SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS ALTERNATE WHERE ALL JOISTS PARALLEL TO INTERIOR WALL
1" = 1'-0"



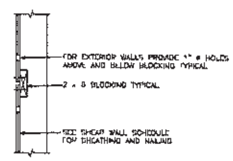
NOTES:

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL
1" = 1'-0"



TYPICAL SHEAR WALL DOUBLE STUD DETAIL AT VERTICAL PLYWOOD JOINT
1" = 1'-0"



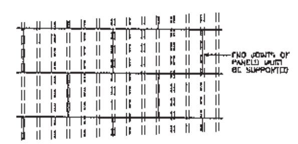
TYPICAL SHEAR WALL BLOCKING DETAIL
1" = 1'-0"

NAILING

1. NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 9 UNDER MATERIALS FOR COMMON NAIL SIZES.
2. UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 2 1/2" NAILS AT 6" O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 10" O/C FOR FLOORS AND AT 12" O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING.
3. DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

SHEATHING

1. A. ROOF SHEATHING — SLOPED ROOF (SLOPE > 1:10) 1/2" PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS. FLAT ROOF (SLOPE < 1:10) 5/8" TONGUE AND GROOVE PLYWOOD.
   B. FLOOR SHEATHING — 5/8" BUTT JOINT PLYWOOD IF 1 1/2" CONCRETE TOPPING IS USED
   C. EXTERIOR WALL SHEATHING — 3/8" PLYWOOD ON EXTERIOR SIDE. 1/2" PLYWOOD SHEATHING IF WALLS CLAD WITH VERTICLE STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
   D. SHEAR WALL SHEATHING — SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS. STAGGER THE JOINTS PARALLEL TO THE JOISTS.



3. DRYWALL OR SHEATHING ON LOAD BEARING WALLS OR SHEAR WALLS SHALL BE FASTENED DIRECTLY TO THE STUDS, WITHOUT THE USE OF RESILIENT METAL CHANNELS.

SHEAR CLIP SCHEDULE 2006 BCBC

TOP OF FLOOR	WALL 1,2,4,5,6	WALL 3
6TH FLOOR	A35 @ 24" O/C	-
5TH FLOOR	A35 @ 12" O/C	A35 @ 8" O/C
4TH FLOOR	A35 @ 8" O/C	A35 @ 8" O/C
3RD FLOOR	A35 @ 8" O/C	A35 @ 8" O/C
2ND FLOOR	A35 @ 8" O/C	A35 @ 6" O/C
1ST FLOOR	A35 @ 8" O/C	A35 @ 6" O/C

SHEAR CLIP SCHEDULE 2010 BCBC

TOP OF FLOOR	WALL 1,2,4,5,6	WALL 3
6TH FLOOR	A35 @ 24" O/C	-
5TH FLOOR	A35 @ 12" O/C	A35 @ 6" O/C
4TH FLOOR	A35 @ 8" O/C	A35 @ 5" O/C
3RD FLOOR	A35 @ 8" O/C	A35 @ 5" O/C
2ND FLOOR	A35 @ 6" O/C	A35 @ 5" O/C
1ST FLOOR	A35 @ 6" O/C	A35 @ 5" O/C

WOOD FRAMING NOTES

GENERAL

1. ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
   - [- ALBERTA BUILDING CODE 2006 - PART 9]
   - [- BRITISH COLUMBIA BUILDING CODE 2006 - PART 9]
   - [- ONTARIO BUILDING CODE 2006 - PART 9]
   - [- VANCOUVER BUILDING BYLAW - PART 9 (THE BUILDING CODE)]
   - CAN/CSA-O86 - ENGINEERING DESIGN IN WOOD
   - CSA O121 - DOUGLAS FIR PLYWOOD
   - CAN/CSA-LO 4000 PARALLAMS AND MICROLLAMS
   - CAN/CSA-O122 - STRUCTURAL GLUED-LAMINATED TIMBER
   - CAN O177 - QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
   - CSA O437 - STRANDBOARD AND WAFERBOARD
   - CSA B111 - WIRE NAILS, SPIKES AND STAPLES
   - CAN/CSA-B34 MISCELLANEOUS BOLTS AND SCREWS
   - CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC
   - "WOOD DESIGN MANUAL" - CANADIAN WOOD COUNCIL
   - "WOOD BUILDING TECHNOLOGY" - CANADIAN WOOD COUNCIL
2. ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
3. CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
4. ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
5. FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
6. ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
7. ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
   A. FLOORS — NOT MORE THAN 1/4" IN 10'-0" OUT OF LEVEL.
   B. WALLS — NOT MORE THAN 1/4" IN 8'-0" OUT OF PLUMB. NOT MORE THAN 1/4" IN 10'-0" FOR ANY BOWING.
   C. OVERALL — BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 3/8" DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

MATERIALS

1. STUDS AND BUILT-UP POSTS TO BE SPF NO. 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS.
2. JOISTS TO BE SPF # 2 GRADE OR BETTER.
3. BUILT-UP BEAMS AND HEADERS TO BE S-P-F # 2 GRADE OR BETTER.
4. WALL PLATES TO BE D. FIR #3/STUD GRADE. WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
5. POSTS AND BEAMS TO BE HEM-FIR # 2 GRADE OR BETTER.
6. ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
7. PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
8. TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
9. NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
2" (50 mm)	0.113" (2.9 mm)	6d
2 1/2" (65 mm)	0.131" (3.3 mm)	8d
3" (75 mm)	0.148" (3.8 mm)	10d
3 1/4" (80 mm)	0.148" (3.8 mm)	12d
3 1/2" (90 mm)	0.162" (4.1 mm)	16d
4" (100 mm)	0.192" (4.9 mm)	20d
4 1/2" (115 mm)	0.207" (5.3 mm)	30d
5" (125 mm)	0.225" (5.8 mm)	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

11. MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
12. ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
13. BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
14. MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.

rjc Read Jones Christoffersen Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2008	100793.0001	S-101	

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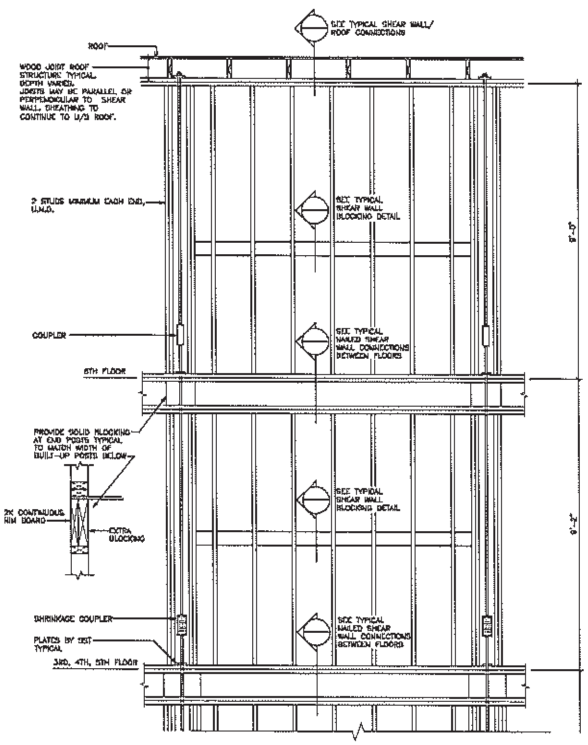
Shear Wall Requirements - 6 Story Building 2006 BCBC						
	SW1	SW2	SW3	SW4	SW5	SW6
Level 6						
Hold Down	SR9			SR5	SR6	SR6
Posts	6-2x6			6-2x6	6-2x6	2-2x6
Sheathing	3/8" o.s.			3/8"	3/8"	3/8"
Nail L	2.5			2.5	2.5	2.5
Nail Spacing	6" o.s.			6"	6"	4"
Level 5						
Hold Down	SR9	SR6	SR9	SR5	SR5	Connect to
Posts	6-2x6	6-2x6	6-2x6	6-2x6	6-2x6	Wall above
Sheathing	3/8" o.s.	3/8" o.s.	1/2" o.s.	3/8"	3/8"	with strap tie
Nail L	2.5	2.5	2.5	2.5	2.5	See plan
Nail Spacing	5" o.s.	6" o.s.	4" o.s.	3"	3"	
Level 4						
Hold Down	SR8	SR7	SR8	SR7	SR7	
Posts	6-2x6	6-2x6	8-2x6	6-2x6	6-2x6	
Sheathing	3/8" o.s.	3/8" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	2.5	2.5	2.5	3	3	
Nail Spacing	4" o.s.	6" o.s.	4" o.s.	3"	3"	
Level 3						
Hold Down	SR9	SR9	SR9	SR7	SR7	
Posts	6-2x6	6-2x6	10-2x6	6-2x6	6-2x6	
Sheathing	1/2" o.s.	3/8" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	2.5	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	3"	3"	
Level 2						
Hold Down	HSR9	SR9	SR9	SR9	SR9	
Posts	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6	
Sheathing	1/2" o.s.	1/2" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	2"	2"	
Level 1						
Hold Down	HSR9	SR9	HSR9	SR9	SR9	
Posts	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6	
Sheathing	1/2" o.s.	1/2" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	2"	2"	

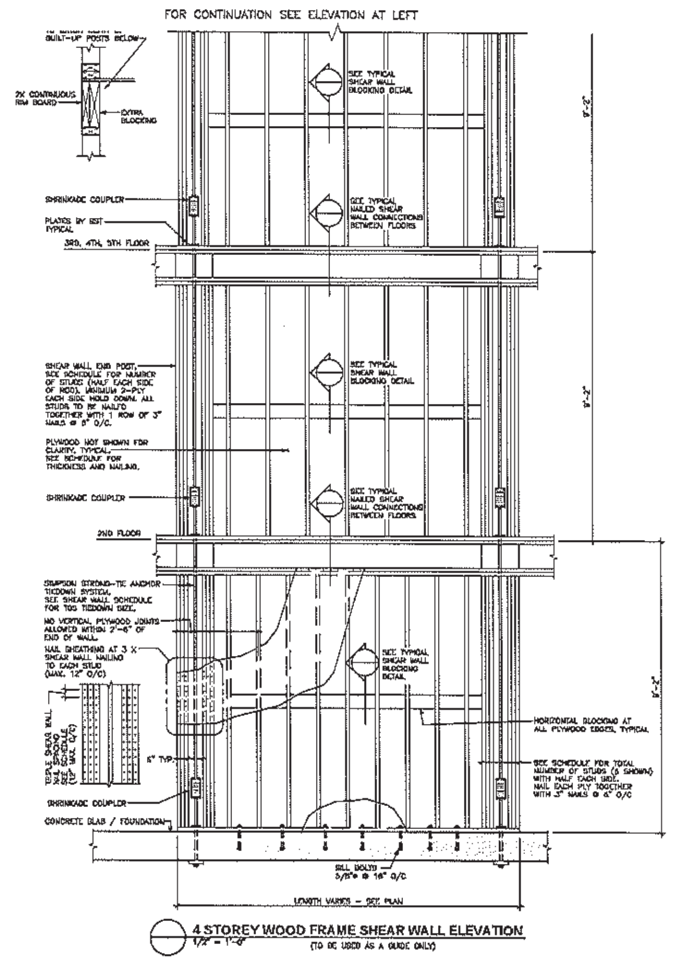
Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level.

Shear Wall Requirements - 6 Story Building 2010 BCBC						
	SW1	SW2	SW3	SW4	SW5	SW6
Level 6						
Hold Down	SR9			SR5	SR5	SR6
Posts	6-2x6			6-2x6	6-2x6	2-2x6
Sheathing	3/8" o.s.			3/8"	3/8"	3/8"
Nail L	2.5			2.5	2.5	2.5
Nail Spacing	6" o.s.			6"	6"	4"
Level 5						
Hold Down	SR9	SR6	SR9	SR6	SR6	Connect to
Posts	6-2x6	6-2x6	6-2x6	6-2x6	6-2x6	Wall above
Sheathing	3/8" o.s.	3/8" o.s.	1/2" o.s.	3/8"	3/8"	with strap tie
Nail L	2.5	2.5	2.5	2.5	2.5	See plan
Nail Spacing	5" o.s.	6" o.s.	4" o.s.	3"	3"	
Level 4						
Hold Down	SR9	SR7	SR9	SR7	SR7	
Posts	6-2x6	6-2x6	8-2x6	6-2x6	6-2x6	
Sheathing	3/8" o.s.	3/8" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	2.5	2.5	2.5	3	3	
Nail Spacing	4" o.s.	5" o.s.	4" o.s.	3"	3"	
Level 3						
Hold Down	SR9	SR9	SR9	SR9	SR9	
Posts	6-2x6	6-2x6	10-2x6	6-2x6	6-2x6	
Sheathing	1/2" o.s.	3/8" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	2.5	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	3"	3"	
Level 2						
Hold Down	HSR9	SR9	SR9	SR9	SR9	
Posts	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6	
Sheathing	1/2" o.s.	1/2" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	2"	2"	
Level 1						
Hold Down	HDR9	SR9	HDR9	HDR9	HDR9	
Posts	8-2x6	8-2x6	10-2x6	8-2x6	8-2x6	
Sheathing	1/2" o.s.	1/2" o.s.	1/2" o.s.	1/2"	1/2"	
Nail L	3	2.5	3	3	3	
Nail Spacing	4" o.s.	4" o.s.	4" o.s.	2"	2"	

Hold Down - ATS as provided by Simpson Strong tie with shrinkage compensators at all levels except for the uppermost level.

Values shown in shading show the only difference between the 2006 BCBC and 2010 BCBC (which includes a 1.2 os)





4 STOREY WOOD FRAME SHEAR WALL ELEVATION
1/2" = 1'-0"
(TO BE USED AS A GUIDE ONLY)

rjc Read Jones Christoffersen
Consulting Engineers

Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X8 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

General Notes

Scale	Date	Project No.	Sketch Number	Rev.
As noted	June 30, 2009	100793.0001	S-102	

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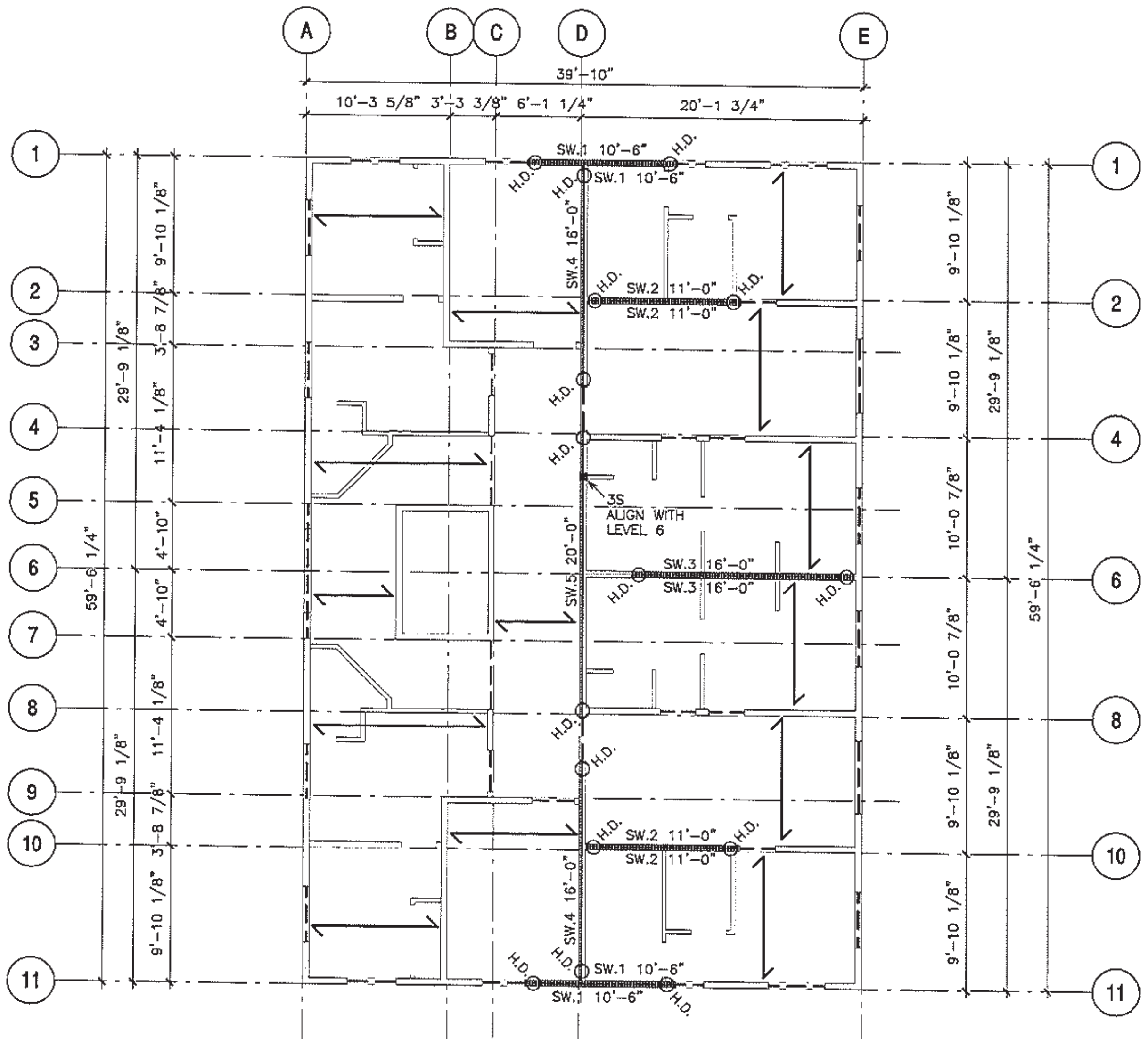

PLYWOOD SHEARWALLS

1. PLYWOOD SHEARWALLS ARE SHOWN ON PLAN AS: XXXXXXXXXXXXXXXXXXXXXX
   S.W.— INDICATES PLYWOOD SHEATHED SIDE OF WALL. SHEATH EACH SIDE WHERE "S.W." IS SHOWN ON BOTH SIDES.
2. ALL PLYWOOD EDGES TO BE BLOCKED WITH MINIMUM 1 1/2" WIDE MEMBERS (2 x 4 MIN.).
3. NAIL PLYWOOD AS PER DETAILS AND SCHEDULE ON DWG. S-102 NAILING SHOWN IN SCHEDULES APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O/C ALONG INTERMEDIATE SUPPORTS.
4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE HOLD-DOWN ANCHORS EACH END OF ALL PLYWOOD SHEARWALLS, AS PER DETAILS ON DRAWING S-102
8. SEE ALSO REQUIREMENTS ON DRAWING S-102 SHEAR WALL DETAILS.
9. MAXIMUM STUD SPACING = 16" O/C FOR ALL SHEARWALLS

LEGEND

– INDICATES JOIST DIRECTION

– INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

* – 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE. NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 – 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES. PROVIDE 3" NAILS @ 6" O.C. EXTRA TO SHEARWALL BLOCKING BELOW AT ALL LOCATIONS.

rjc
Read Jones Christoffersen
Consulting Engineers
Vancouver • Victoria • Nanaimo • Calgary • Edmonton • Toronto
Suite 300, 1285 West Broadway, Vancouver, BC V6H 3X6 Canada
Office 604 738-0048 Fax 604 738-1107 www.rjc.ca

FORINTEK STUDY
6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

1st Floor Walls Showing 2nd Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	100793.0001	S-201	

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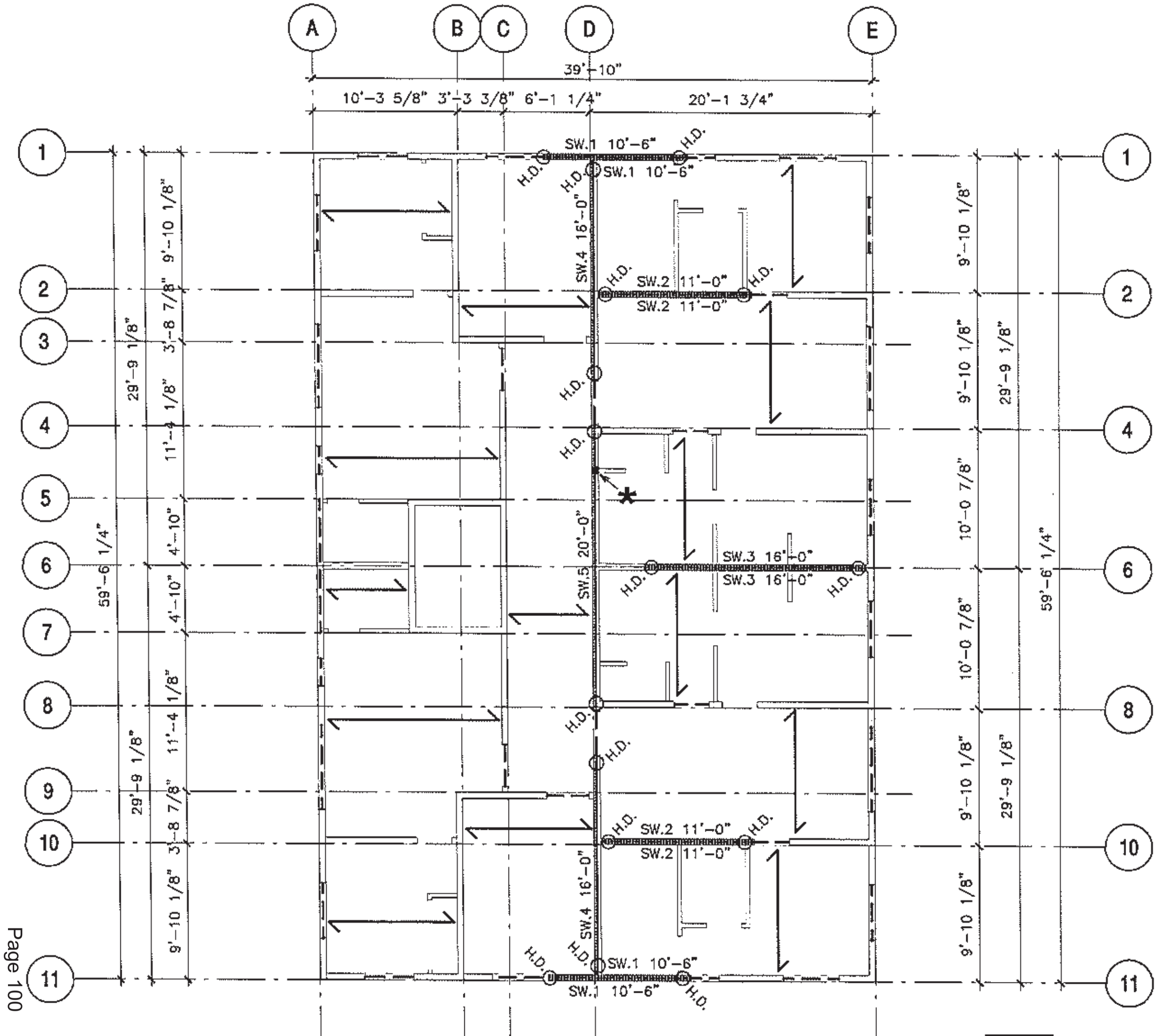

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4. BLOCK ALL UNSUPPORTED EDGES WITH 2 x 6 BLOCKING ON FLAT AS PER TYPICAL SHEARWALL BLOCKING DETAIL.
5. DOUBLE STUDS ARE REQUIRED AT ALL VERTICAL PLYWOOD JOINTS WHERE NAIL SPACING IS 2 1/2" OR LESS FOR 2 1/2" NAILS AND 3" OR LESS FOR 3" NAILS. CONNECT STUDS TOGETHER WITH 3" NAILS TO MATCH SPACING SHOWN ON SHEARWALL SCHEDULE.
6. PROVIDE HOLD-DOWN SYSTEM AS MANUFACTURED BY SIMPSON STRONG TIE ONLY. INTALL AS PER MANUFACTURERS RECOMMENDATIONS.
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LEGEND

- INDICATES JOIST DIRECTION

- INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

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Consulting Engineers
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FORINTEK STUDY - 6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010
2nd Floor Walls Showing 3rd Floor Framing Over
3rd Floor Walls Showing 4th Floor Framing Over
4th Floor Walls Showing 5th Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	100793.0001	S-202	

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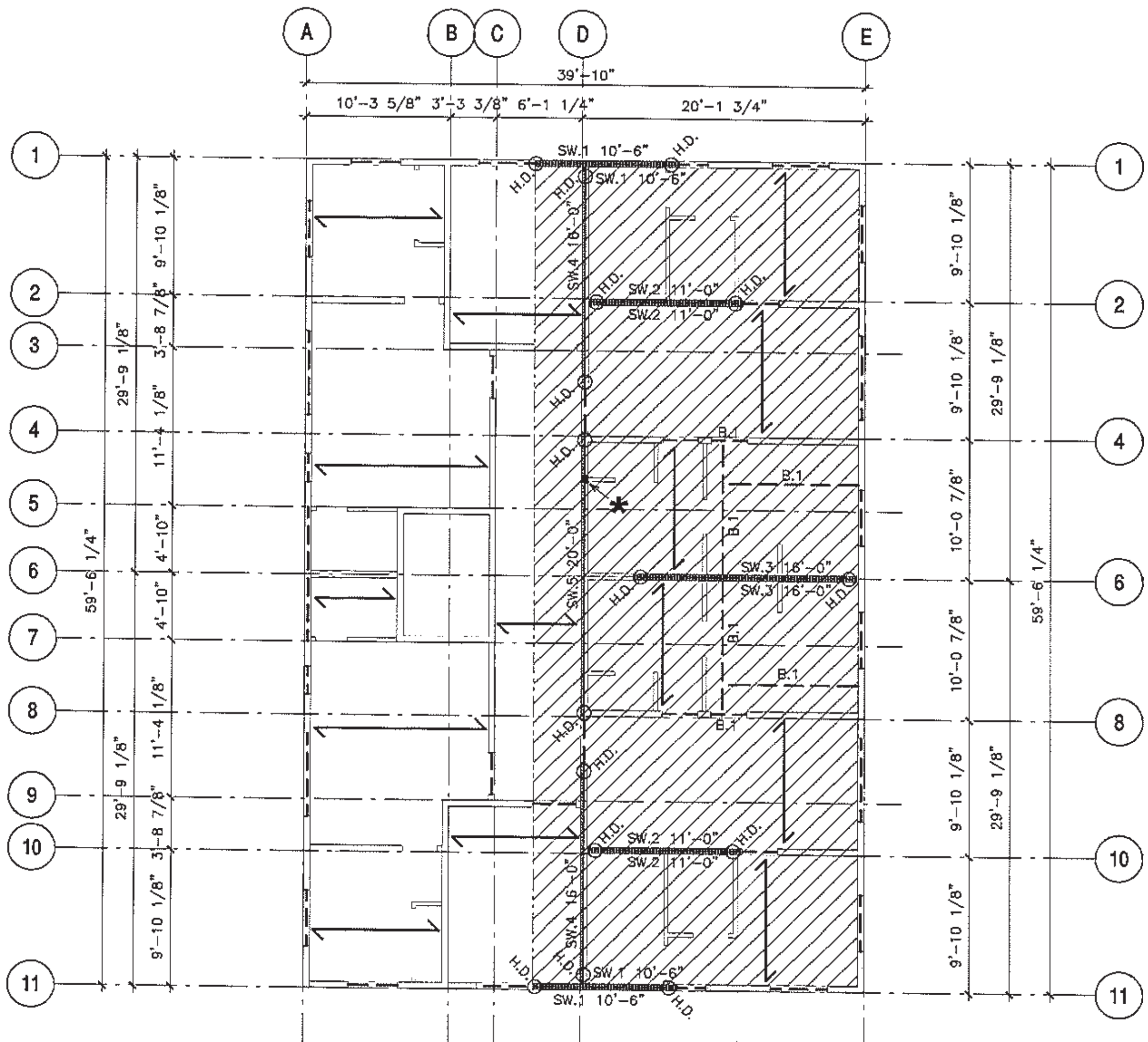

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LEGEND

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– INDICATES LEAD BEARING WALL (2x6)

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DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES.

AT HATCHED AREA ON PLAN PROVIDE 2x4 BLOCKING ON FLAT AT ALL UNSUPPORTED PLYWOOD EDGES. NAIL ALL PANEL PERIMETERS WITH 3" NAILS @ 4" O.C. NAIL SHEATHING TO SHEARWALL BLOCKING BELOW WITH 3" NAILS @ 4" O.C.

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FORINTEK STUDY
6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

5th Floor Walls Showing 6th Floor Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	100793.0001	S-203	

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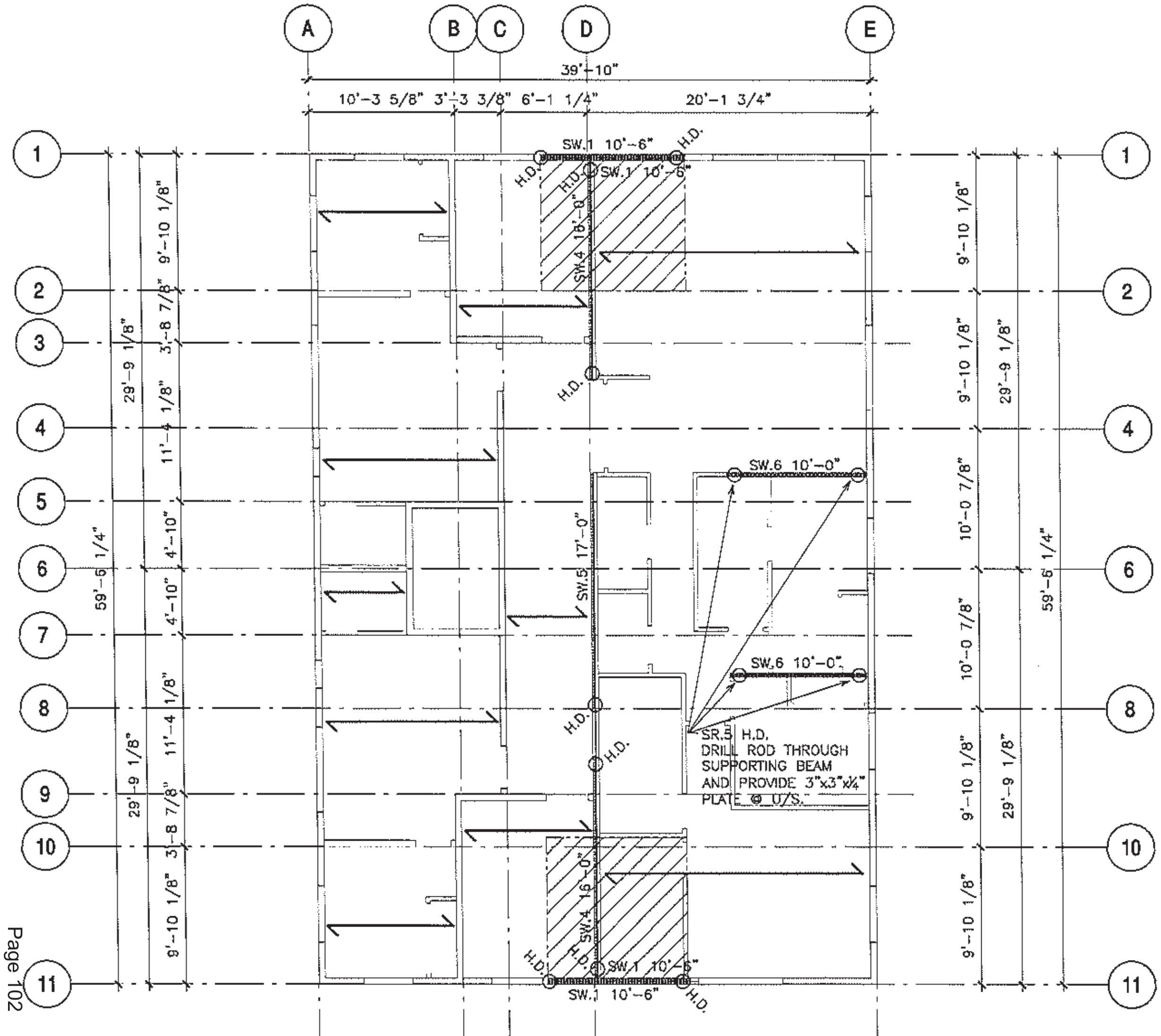

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LEGEND

- INDICATES JOIST DIRECTION
- INDICATES LEAD BEARING WALL (2x6)

SW.X – INDICATES SHEARWALL

* – 3S
ALIGN WITH LEVEL 6.
STRAP LEVEL 5 TO LEVEL 6 STUDS WITH SIMPSON STRONG TIE CMST 52 STRAP TIE. NAIL SHEATHING TO EACH STUD AT LEVEL 5 AND LEVEL 6 WITH 2½" NAILS @ 6" O.C.

B.1 – 5¼" x 9½" PARALLAM TO CARRY SW.6 ABOVE. STRAP END TO SUPPORTING STUDS WITH SIMPSON STRONG TIE TS22 STRAP TIE EACH SIDE EACH END. PROVIDE POST SIZE TO MATCH BEAM WIDTH.

DIAPHRAGM NAILING

NAIL PLYWOOD SHEATHING AS PER GENERAL NOTES. PROVIDE 3" NAILS @ 4" O.C. EXTRA TO THE TOP OF ALL SHEARWALL BLOCKING BELOW.

AT HATCHED AREA ON PLAN PROVIDE 2x4 BLOCKING ON FLAT AT ALL UNSUPPORTED PLYWOOD EDGES. NAIL ALL PANEL PERIMETERS WITH:
-3" NAILS @ 4" O.C. BCBC 2006
-3" NAILS @ 2.5" O.C. BCBC 2010
NAIL SHEATHING TO SHEARWALL BLOCKING BELOW WITH 3" NAILS @ 4" O.C.

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FORINTEK STUDY
6 STOREY NEESWOOD BUILDING
BCBC 2006 & 2010

6th Floor Walls Showing Roof Framing Over

Scale	Date	Project No.	Sketch Number	Rev.
1/8" = 1'-0"	June 30, 2009	100793.0001	S-204	

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Appendix B

Selected Design Calculations of Shearwalls in Representative and NEESWood Wood-Frame Buildings

B-1) Design of Wall 4 in 6 storey Representative Wood Frame Buildings

6 Story Shear Wall Example
GN/2005 spreadsheets/wood shearwall March 28 2008

6 Story 9.75m Party Wall

lw = 9.75 m Rd = 3.00
Species = HemFir Ro = 1.70
d = 9.3 m Deflection Multiplier ($Vo_{deflection}/Vo$) = 1.00 (Can use $Vo_{deflection}$ based on T calculated with no upper limit)

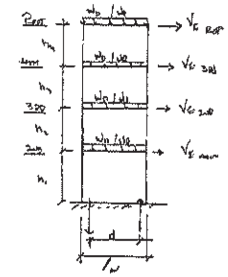
SHEAR DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Vo (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Vo (kN)	vo = Σ Vo/lw (kN/m)	Sheathing / Nailing: t plywood (in)	nail length (in)	nail spacing (mm)	vo/nail (N)	vr (kN/m)	vr/vo
Roof	1.7	3.7	22.38										
4.53				10.58	36.08	22.37503	2.29	8/16	2.5	150	344	5.72	2.49
6th	1.1	1.1	23.33										
2.78				27.30	46.80	45.70158	4.69	8/16	2.5	150	703	5.72	1.22
5th	1.1	1.1	18.66										
2.78				38.03	57.53	64.36234	6.60	8/16	2.5	100	660	8.29	1.26
4th	1.1	1.1	14.00										
2.78				48.75	68.25	78.35791	8.04	8/16	2.5	100	804	8.29	1.03
3rd	1.1	1.1	9.33										
2.78				59.48	78.98	87.68829	8.99	8/16	2.5	75	675	10.7	1.19
2nd floor	1.1	1.1	4.67										
2.78				70.20	89.70	92.35348	9.47	8/16	2.5	75	710	10.7	1.13

FLEXURE DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Vo (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Vo (kN)	Mf kNm	Tf (kN)	Cf (kN)	vr/vo	ATS Specified: Tf *1.2 (kN)	ATS	Ae (mm²)	Tr (kN)
Roof	1.7	3.7	22.37503											
4.53				16.58	36.08	22.38	101.36	2.61	28.21	2.49	3.13	SR5	166.65	42.25
6th	1.1	1.1	23.32585											
2.78				27.30	46.80	45.70	228.41	10.91	49.91	1.22	13.09	SR5	166.65	42.25
5th	1.1	1.1	18.66076											
2.78				38.03	57.53	64.36	407.34	24.79	77.19	1.26	29.74	SR5	166.65	42.25
4th	1.1	1.1	13.99557											
2.78				48.75	68.25	78.36	625.17	42.85	108.66	1.03	51.42	SR7	334.01	85.79
3rd	1.1	1.1	9.33038											
2.78				59.48	78.98	87.69	868.05	63.70	142.92	1.19	76.44	SR9	551.87	141.06
2nd floor	1.1	1.1	4.66519											
2.78				70.20	89.70	92.35	1125.69	85.84	178.57	1.13	103.13	SR9	551.87	141.96

4 Story Shear Wall



Load/nail (N)	Nail Slip per CSA 086.1 – Common Nail Length (inch): 2	2.5	3	Nail Slip / Vo – Nail Size / Slip: 2	2.5	3
300	0.46	0.29	0.23	0.503	0.365	0.283
400	0.76	0.46	0.35			
500	1.2	0.64	0.49	error	1.225	0.868
600	1.89	0.88	0.66			
700	2.97	1.21	0.86	2.539	1.078	0.780
800		1.7	1.13			
900		2.33	1.48	error	1.723	1.143
1000			1.95			
				2.695	1.126	0.809
				error	1.261	0.888

ATS System

ATS	Size	Ag in²	Ae in²	(.4Ag+.6Ae) in²	(.4Ag+.6Ae) mm²	Tr (kN) kN
	1/2	0.196	0.149	0.168	108.3	
SR5	5/8	0.307	0.226	0.258	166.7	42.25
	3/4	0.442	0.334	0.377	243.3	
SR7	7/8	0.601	0.462	0.518	334.0	85.70
	1	0.785	0.606	0.678	437.3	
SR9	1 1/8	0.994	0.763	0.855	551.9	141.96
HSR9	1 1/8	0.994	0.763	0.855	551.9	303.74
SR10	1 1/4	1.227	0.909	1.072	691.8	303.74

DEFLECTION INFORMATION

h (m)	Ve (kN)	Σ Ve (kN)	Mf kNm	Tf/Cf kN	$A_{comp\ mem}$ mm^2	$E_{comp\ mem}$ GPa	$A_{tens\ mem}$ mm^2	$E_{tens\ mem}$ GPa	x m	$I_{transformed}$ m^4	Bv tbl 7.3 CSA086 (N/mm)	en mm	Δa mm	Δa * Tr / Tf mm
Roof	22.37563													
4.53		22.37563	101.36	10.90	13528	11	166.65	200	1.70187	0.21411	6900	0.37	2	2.0000
6th	23.32595													
2.78		45.70158	228.41	24.56	13528	11	166.65	200	1.70187	0.21411	6900	1.23	1	0.2582
5th	18.66076													
2.78		64.36234	407.34	43.80	20292	11	166.65	200	1.20829	0.22802	6900	1.08	1	0.5867
4th	13.99557													
2.78		78.35791	625.17	67.22	20292	11	334.01	200	2.14218	0.40426	6900	1.72	1	0.4905
3rd	9.33038													
2.78		87.68829	868.95	93.44	27056	11	551.87	200	2.51593	0.63306	6900	1.13	1	0.4487
2nd floor	4.66519													
2.78		92.35348	1125.09	121.04	27056	11	551.87	200	2.51593	0.63306	6900	1.26	1	0.6054

DEFLECTION CALCULATOINS

h m	Δv mm	Θv rad	Δv_{total} mm	Δm mm	Θm rad	Δm_{total} mm	Δ_{bv} mm	Δ_{en} mm	Δ_{hd} mm	Θ_{hd} rad	Δhd_{total} mm	$\sum\Delta_{total}$ mm	Δtotal	Δtotal x RdRo defl (mm)	Interstory defl (mm)	Interstory drift (%)
Roof	0.294	0.000097	1.844255	0.000	0.000000	5.544	1.507	4.136	0.929	0.000205	2.043597	15.07	89.11	454.462	76.882	1.697
4.53																
6th	0.139	0.000075	0.881653	0.166	0.000120	3.236	1.889	8.515	0.074	0.000026	0.683872	15.21	74.04	377.580	77.547	2.790
2.78																
5th	0.184	0.000099	0.650802	0.352	0.000253	2.718	2.060	7.495	0.167	0.000060	0.610241	14.13	58.83	300.033	72.082	2.593
2.78																
4th	0.126	0.000088	0.403035	0.354	0.000255	2.012	3.238	11.076	0.142	0.000051	0.442081	18.07	44.70	227.951	92.171	3.316
2.78																
3rd	0.000	0.000049	0.232650	0.347	0.000250	1.311	3.624	7.825	0.128	0.000046	0.300553	13.29	26.82	135.779	67.796	2.439
2.78																
2nd floor	0.095	0.000051	0.094079	0.482	0.000347	0.482	3.816	6.764	0.173	0.000062	0.172615	13.33	13.33	67.084	67.084	2.445
2.78																

6 Story Shear Wall Example

GN/2005 spreadsheets/wood shearwall March 28 2008

SW1 - 10'-6" 2006 BCBC

lw =	3.2 m	Rd =	3.00		
Species =	SPF	Ro =	1.70		
d =	2.746 m	Deflection Multiplier ($Ve_{deflection}$/Ve) =		0.50	(Can use $Ve_{deflection}$ based on T calculated with no upper limit)

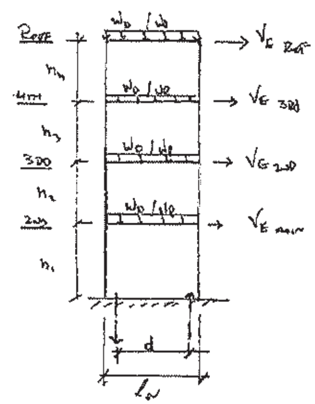
SHEAR DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	ve - Σ Ve/lw (kN/m)	Sheathing / Nailing: plywood (in)	nail length (in)	spacing (m	ve/nail (N)	vr (kN/m)	vr/ve
Roof	0.225	0.516	14.10										
2.78				0.72	1.65	14.1	4.41	12/16	2.5	75	165	7.72	1.75
6th	3	3	9.92										
2.78				10.32	11.25	24.02	7.51	12/16	2.5	62.5	235	9.46	1.26
5th	3	3	7.95										
2.78				19.92	20.85	31.97	9.99	12/16	2.5	50	250	11.2	1.12
4th	3	3	5.95										
2.78				29.52	30.45	37.92	11.85	1	2.5	50	296	13.26	1.12
3rd	3	3	3.97										
2.78				39.12	40.05	41.89	13.09	1	3	50	327	16	1.22
2nd floor	3	3	1.99										
2.78				48.72	49.65	43.88	13.71	1	3	50	343	16	1.17

FLEXURE DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	Mf kNm	Tf Mf/d-Σ(wd X lw)/2 (kN)	Cf Mf/d+Σ((wd+.5wl)X lw)/2 (kN)	vr/ve	ATS Specified: Tf *1.2 (kN)	ATS	Ae (mm²)	Tr (kN)
Roof	0.225	0.516	14.1											
2.78				0.72	1.65	14.10	39.20	13.91	15.05	1.75	16.70	SR9	551.87	141.96
6th	3	3	9.92											
2.78				10.32	11.25	24.02	105.97	33.43	46.56	1.26	40.12	SR9	551.87	141.96
5th	3	3	7.95											
2.78				19.92	20.85	31.97	194.85	61.00	86.13	1.12	73.20	SR9	551.87	141.96
4th	3	3	5.95											
2.78				29.52	30.45	37.92	300.27	94.59	131.72	1.12	113.50	SR9	551.87	141.96
3rd	3	3	3.97											
2.78				39.12	40.05	41.89	416.72	132.20	181.33	1.22	158.64	HSR9	551.87	303.74
2nd floor	3	3	1.99											
2.78				48.72	49.65	43.88	538.71	171.82	232.95	1.17	206.18	HSR9	551.87	303.74

4 Story Shear Wall



Load/nail (N)	Nail Slip per CSA 086.1 Common Nail Length 2	2.5
300	0.46	0.29
400	0.76	0.46
500	1.2	0.64
600	1.89	0.88
700	2.97	1.21
800		1.7
900		2.33
1000		

ATS	Size	Ag in²
	1/2	0.196
SR5	5/8	0.307
	3/4	0.442
SR7	7/8	0.601
	1	0.785
SR9	1 1/8	0.994
HSR9	1 1/8	0.994

DEFLECTION INFORMATION

h (m)	Ve (kN)	$\sum$ Ve (kN)	Mf kNm	Tf/Cf kN	$A_{comp\ mem}$ mm^2	$E_{comp\ mem}$ GPa	$A_{tens\ mem}$ mm^2	$E_{tens\ mem}$ GPa	x m	$I_{transformed}$ m^4	Bv tbl 7.3 CSA086 (N/mm)	en mm	Δa mm	Δa * Tr / Tf mm
Roof	14.1													
2.78		14.1	39.20	14.27	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	2	2.0000
6th	9.92													
2.78		24.02	105.97	38.59	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	1	0.2355
5th	7.95													
2.78		31.97	194.85	70.96	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	1	0.4297
4th	5.95													
2.78		37.92	300.27	109.35	31920	9.5	551.87	200	0.73277	0.06423	13800	0.29	1	0.6663
3rd	3.97													
2.78		41.89	416.72	151.76	42560	9.5	551.87	200	0.58887	0.06882	13800	0.26	1	0.4352
2nd floor	1.99													
2.78		43.88	538.71	196.18	42560	9.5	551.87	200	0.58887	0.06882	13800	0.28	1	0.5657

DEFLECTION CALCULATOINS

h m	Δv mm	Θv rad	Δv_{total} mm	Δm mm	Θm rad	Δm_{total} mm	Δ_{Bv} mm	Δ_{en} mm	Δ_{hd} mm	Θ_{hd} rad	Δhd_{total} mm	$\sum\Delta_{total}$ mm	Δtotal	Δtotal x RdRo defl (mm)	Interstory defl (mm)	Interstory drift (%)
Roof	0.083	0.000045	1.614049	0.000	0.000000	6.391	0.557	2.016	1.738	0.000625	3.763762	14.34	62.89	320.717	73.140	2.631
2.78																
6th	0.141	0.000076	1.460823	0.124	0.000089	6.267	0.949	2.016	0.205	0.000074	2.026262	12.72	48.54	247.577	64.862	2.333
2.78																
5th	0.188	0.000101	1.226055	0.336	0.000241	5.807	1.262	2.016	0.373	0.000134	1.821669	12.13	35.83	182.715	61.878	2.226
2.78																
4th	0.223	0.000120	0.927173	0.617	0.000444	4.855	1.194	2.016	0.579	0.000208	1.448382	10.44	23.69	120.837	53.241	1.915
2.78																
3rd	0.229	0.000124	0.589925	0.887	0.000638	3.350	1.319	1.826	0.378	0.000136	0.869537	7.95	13.25	67.597	40.567	1.459
2.78																
2nd floor	0.240	0.000130	0.240330	1.231	0.000886	1.231	1.381	1.956	0.491	0.000177	0.491434	5.30	5.30	27.030	27.030	0.972
2.78																

th (inch)	Nail Slip / Ve		
	Nail Size / Slip		
3	2	2.5	3
0.23	0.460	0.290	0.230
0.35			
0.49	0.460	0.290	0.230
0.66			
0.86	0.460	0.290	0.230
1.13			
1.48	0.460	0.290	0.230
1.95			
	0.542	0.336	0.263
	0.588	0.363	0.281

Ve	lw total (m)	$Ve*lw_{total}/lw$
259	79	10.5
270	79	10.9
216	79	8.7
162	79	6.6
108	79	4.4
54	79	2.2
1069		

Ae in^2	(.4Ag+.6Ao) in^2	(.4Ag+.6Ao) mm^2	Tr (kN) kN
0.149	0.168	108.3	
0.226	0.258	166.7	42.25
0.334	0.377	243.3	
0.462	0.518	334.0	85.79
0.606	0.678	437.3	
0.763	0.855	551.9	141.96
0.763	0.855	551.9	303.74

Tf*1.2		Tr	Δa HD Slip (m	kN/slip
16.70	2- HDU5	60.00	2.92	25.11
40.12	2-HDU5	60.00	2.90	25.11
73.20	2-HDU8	96.00	2.91	35.01
113.50	2- HDU8	96.00	2.87	35.01
158.64	2- HDU11	125.30	3.48	49.70
206.18	2- HDU14	146.50	4.50	66.30

B-2) Design of Wall 5 in 6 storey NEESWood Wood Frame Buildings

6 Story Shear Wall Example
GN/2005 spreadsheets/wood shearwall March 28 2008

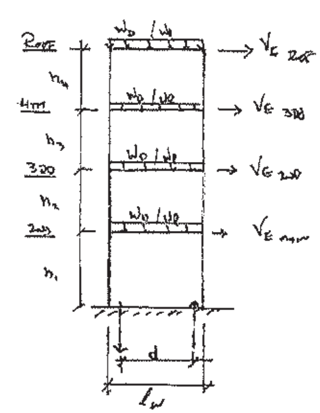
SW1 - 10'-6" 2006 BCBC

lw = 3.2 m Rd = 3.00
Species = SPF Ro = 1.70
d = 2.746 m Deflection Multiplier ($Ve_{deflectin}$/Ve) = 1.00 (Can use $Ve_{deflection}$ based on T calculated with no upper limit)

SHEAR DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	ve - Σ Ve/lw (kN/m)	Sheathing / Nailing: plywood (in	nail length (in	spacing (m	ve/nail (N)	vr (kN/m)	vr/ve
Roof	0.225	0.516	18.90										
2.78				0.72	1.65	18.9	5.91	12/16	2.5	75	443	7.72	1.31
6th	3	3	9.92										
2.78				10.32	11.25	28.82	9.01	12/16	2.5	62.5	563	9.46	1.05
5th	3	3	7.95										
2.78				19.92	20.85	36.77	11.49	12/16	2.5	50	575	11.2	0.97
4th	3	3	5.95										
2.78				29.52	30.45	42.72	13.35	1	2.5	50	668	13.26	0.99
3rd	3	3	3.97										
2.78				39.12	40.05	46.69	14.59	1	3	50	730	16	1.10
2nd floor	3	3	1.99										
2.78				48.72	49.65	48.68	15.21	1	3	50	761	16	1.05

4 Story Shear Wall



Load/nail (N)	Nail Slip per CSA 086.1 Common Nail Lengt 2	2.5
300	0.46	0.29
400	0.76	0.46
500	1.2	0.64
600	1.89	0.88
700	2.97	1.21
800		1.7
900		2.33
1000		

FLEXURE DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	Mf kNm	Tf Mf/d-Σ(wd X lw)/2 (kN)	Ct Mf/d+Σ((wd+.5wl)X lw)/2 (kN)	vr/ve	ATS Specified: Tf *1.2 (kN)	ATS	Ae (mm²)	Tr (kN)
Roof	0.225	0.516	18.9											
2.78				0.72	1.65	18.90	52.54	18.77	19.91	1.31	22.53	SR9	551.87	141.96
6th	3	3	9.92											
2.78				10.32	11.25	28.82	132.66	43.15	56.28	1.05	51.78	SR9	551.87	141.96
5th	3	3	7.95											
2.78				19.92	20.85	36.77	234.88	75.58	100.71	0.97	90.69	SR9	551.87	141.96
4th	3	3	5.95											
2.78				29.52	30.45	42.72	353.64	114.03	151.16	0.99	136.83	SR9	551.87	141.96
3rd	3	3	3.97											
2.78				39.12	40.05	46.69	483.44	156.49	205.63	1.10	187.79	HSR9	551.87	303.74
2nd floor	3	3	1.99											
2.78				48.72	49.65	48.68	618.77	200.98	262.11	1.05	241.17	HSR9	551.87	303.74

ATS System

ATS	Size	Ag in²	Ao in²	(.4Ag+.6Ao) in²	(.4Ag+.6Ae) mm²
	1/2	0.196	0.149	0.168	108.3
SR5	5/8	0.307	0.226	0.258	166.7
	3/4	0.442	0.334	0.377	243.3
SR7	7/8	0.601	0.462	0.518	334.0
	1	0.785	0.606	0.678	437.3
SR9	1 1/8	0.994	0.763	0.855	551.9
HSR9	1 1/8	0.994	0.763	0.855	551.9

DEFLECTION INFORMATION

h (m)	Ve (kN)	$\sum$ Ve (kN)	Mf kNm	Tf/Cf kN	$A_{comp\ mom}$ mm^2	$E_{comp\ mom}$ GPa	$A_{tens\ mom}$ mm^2	$E_{tens\ mom}$ GPa	x m	$I_{transformed}$ m^4	Bv tbl 7.3 CSA086 (N/mm)	en mm	Δa mm	Δa * Tr / Tf mm
Roof	18.9													
2.78		18.9	52.54	19.13	31920	9.5	551.87	200	0.73277	0.06423	11000	0.54	2	2.0000
6th	9.92													
2.78		28.82	132.66	48.31	31920	9.5	551.87	200	0.73277	0.06423	11000	0.79	1	0.3040
5th	7.95													
2.78		36.77	234.88	85.54	31920	9.5	551.87	200	0.73277	0.06423	11000	0.82	1	0.5324
4th	5.95													
2.78		42.72	353.64	128.79	31920	9.5	551.87	200	0.73277	0.06423	13800	1.10	1	0.8032
3rd	3.97													
2.78		46.69	483.44	176.05	42560	9.5	551.87	200	0.58887	0.06882	13800	0.94	1	0.5152
2nd floor	1.99													
2.78		48.68	618.77	225.34	42560	9.5	551.87	200	0.58887	0.06882	13800	1.02	1	0.6617

DEFLECTION CALCULATOINS

h m	Δv mm	Θv rad	Δv_{total} mm	Δm mm	Θm rad	Δm_{total} mm	Δ_{Bv} mm	Δ_{en} mm	Δ_{hd} mm	Θ_{hd} rad	Δhd_{total} mm	$\sum\Delta_{total}$ mm	Δtotal	Δtotal x RdRo defl (mm)	Interstory defl (mm)	Interstory drift (%)
Roof	0.222	0.000120	3.695691	0.000	0.000000	15.216	1.493	3.735	1.738	0.000625	4.184293	28.32	143.25	730.562	144.447	5.196
2.78																
6th	0.338	0.000183	3.304733	0.333	0.000239	14.883	2.276	5.497	0.264	0.000095	2.446793	28.41	114.92	586.115	144.879	5.211
2.78																
5th	0.432	0.000233	2.750690	0.840	0.000604	13.710	2.904	5.691	0.463	0.000166	2.182724	27.24	86.52	441.236	138.917	4.997
2.78																
4th	0.501	0.000271	2.068420	1.487	0.001070	11.383	2.689	7.664	0.698	0.000251	1.720222	25.52	59.28	302.319	130.176	4.683
2.78																
3rd	0.511	0.000276	1.311298	2.090	0.001504	7.805	2.939	6.531	0.448	0.000161	1.022425	19.61	33.75	172.143	100.006	3.597
2.78																
2nd floor	0.533	0.000288	0.533238	2.857	0.002056	2.857	3.065	7.115	0.575	0.000207	0.574827	14.14	14.14	72.137	72.137	2.595
2.78																

$\boxed{\Delta @ 2/3h}$ 86.52

Problem is the Δ is not linear for nail slip and therefore K/Δ is not uniform in the elastic range. This creates an issue when calculating a mechanics based T
If you base the wall deflection using 1 for deflectoin, you get one value. If you use a smaller value than 1, than deflection is not linear.
I suggest calculating Δ/K using a deflection factor of 1, ie at the factored loads as that is what the forces are expected to be.

Ve =	48.68	T = 2 pi / Ω
m=Ve /.087/9.81	57037.74	Ω = sqrt (k/m)
k =	562664.51	k = Ve/Δ
Ω =	3.14	
T =	2.00	
where Ve = .123 W		

th (inch)	Nail Slip / Ve		
	Nail Size / Slip		
3	2	2.5	3
0.23	0.949	0.537	0.410
0.35			
0.49	1.634	0.791	0.597
0.66			
0.86	1.714	0.819	0.617
1.13			
1.48	2.619	1.103	0.795
1.95			
	error	1.355	0.940
	error	1.507	1.024

Ve	lw total (m)	Ve*lw $_{total}$/lw
259	79	10.5
270	79	10.9
216	79	8.7
162	79	6.6
108	79	4.4
54	79	2.2
1069		

Tr (kN) kN
42.25
85.79
141.96
303.74

Tf*1.2		Tr	Δa HD Slip (m	kN/slip
22.53	2- HDU5	60.00	2.92	25.11
51.78	2-HDU5	60.00	2.90	25.11
90.69	2-HDU8	96.00	2.91	35.01
136.83	2- HDU8	96.00	2.87	35.01
187.79	2- HDU11	125.30	3.48	49.70
241.17	2- HDU14	146.50	4.50	66.30

6 Story Shear Wall Example

GN/2005 spreadsheets/wood shearwall March 28 2008

SW1 - 10'-6" 2006 BCBC

lw =	3.2 m	Rd =	3.00	
Species =	SPF	Ro =	1.70	
d =	2.746 m	Deflection Multiplier ($Ve_{deflectin}$/Ve) =		0.50 (Can use $Ve_{deflection}$ based on T calculated with no upper limit)

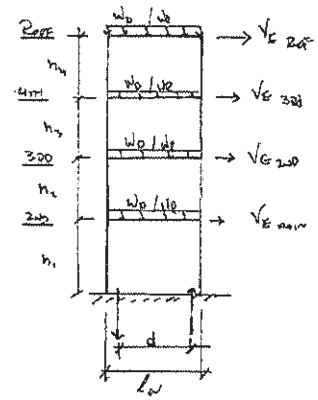
SHEAR DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	ve = Σ Ve/lw (kN/m)	Sheathing / Nailing: plywood (in	nail length (in	nail spacing (m	ve/nail (N)	vr (kN/m)	vr/ve
Roof	0.225	0.516	14.10										
2.78				0.72	1.65	14.1	4.41	12/16	2.5	75	165	7.72	1.75
6th	3	3	9.92										
2.78				10.32	11.25	24.02	7.51	12/16	2.5	62.5	235	9.46	1.26
5th	3	3	7.95										
2.78				19.92	20.85	31.97	9.99	12/16	2.5	50	250	11.2	1.12
4th	3	3	5.95										
2.78				29.52	30.45	37.92	11.85	1	2.5	50	296	13.26	1.12
3rd	3	3	3.97										
2.78				39.12	40.05	41.89	13.09	1	3	50	327	16	1.22
2nd floor	3	3	1.99										
2.78				48.72	49.65	43.88	13.71	1	3	50	343	16	1.17

FLEXURE DESIGN

h (m)	wd (kN/m)	wl (kN/m)	Ve (kN)	Σ(wd X lw) (kN)	Σ(wl X lw) (kN)	Σ Ve (kN)	Mf kNm	Tf Mf/d-Σ(wd X lw)/2 (kN)	Cf Mf/d+Σ((wd+.5wl)X lw)/2 (kN)	vr/ve	ATS Specified: Tf *1.2 (kN)	ATS	Ae (mm²)	Tr (kN)
Roof	0.225	0.516	14.1											
2.78				0.72	1.65	14.10	39.20	13.91	15.05	1.75	16.70	SR9	551.87	141.96
6th	3	3	9.92											
2.78				10.32	11.25	24.02	105.97	33.43	46.56	1.26	40.12	SR9	551.87	141.96
5th	3	3	7.95											
2.78				19.92	20.85	31.97	194.85	61.00	86.13	1.12	73.20	SR9	551.87	141.96
4th	3	3	5.95											
2.78				29.52	30.45	37.92	300.27	94.59	131.72	1.12	113.50	SR9	551.87	141.96
3rd	3	3	3.97											
2.78				39.12	40.05	41.89	416.72	132.20	181.33	1.22	158.64	HSR9	551.87	303.74
2nd floor	3	3	1.99											
2.78				48.72	49.65	43.88	538.71	171.82	232.95	1.17	206.18	HSR9	551.87	303.74

4 Story Shear Wall



Load/nail (N)	Nail Slip per CSA 086.1 Common Nail Lengt: 2	2.5
300	0.46	0.29
400	0.76	0.46
500	1.2	0.64
600	1.89	0.88
700	2.97	1.21
800		1.7
900		2.33
1000		

ATS	Size	Ag in²
	1/2	0.196
SR5	5/8	0.307
	3/4	0.442
SR7	7/8	0.601
	1	0.785
SR9	1 1/8	0.994
HSR9	1 1/8	0.994

DEFLECTION INFORMATION

h (m)	Ve (kN)	Σ Ve (kN)	Mf kNm	Tf/Cf kN	$A_{comp\ mem}$ mm^2	$E_{comp\ mem}$ GPa	$A_{tens\ mem}$ mm^2	$E_{tens\ mem}$ GPa	x m	$I_{transformed}$ m^4	Bv tbl 7.3 CSA086 (N/mm)	en mm	Δa mm	Δa * Tr / Tf mm
Roof	14.1													
2.78		14.1	39.20	14.27	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	2	2.0000
6th	9.92													
2.78		24.02	105.97	38.59	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	1	0.2355
5th	7.95													
2.78		31.97	194.85	70.96	31920	9.5	551.87	200	0.73277	0.06423	11000	0.29	1	0.4297
4th	5.95													
2.78		37.92	300.27	109.35	31920	9.5	551.87	200	0.73277	0.06423	13800	0.29	1	0.6663
3rd	3.97													
2.78		41.89	416.72	151.76	42560	9.5	551.87	200	0.58887	0.06882	13800	0.26	1	0.4352
2nd floor	1.99													
2.78		43.88	538.71	196.18	42560	9.5	551.87	200	0.58887	0.06882	13800	0.28	1	0.5657

DEFLECTION CALCULATOINS

h m	Δv mm	Θv rad	$Δv_{total}$ mm	Δm mm	Θm rad	$Δm_{total}$ mm	$Δ_{Bv}$ mm	$Δ_{en}$ mm	$Δ_{hd}$ mm	$Θ_{hd}$ rad	$Δhd_{total}$ mm	$ΣΔ_{total}$ mm	Δtotal	Δtotal x RdRo defl (mm)	Interstory defl (mm)	Interstory drift (%)
Roof	0.083	0.000045	1.614049	0.000	0.000000	6.391	0.557	2.016	1.738	0.000625	3.763762	14.34	62.89	320.717	73.140	2.631
2.78																
6th	0.141	0.000076	1.460823	0.124	0.000089	6.267	0.949	2.016	0.205	0.000074	2.026262	12.72	48.54	247.577	64.862	2.333
2.78																
5th	0.188	0.000101	1.226055	0.336	0.000241	5.807	1.262	2.016	0.373	0.000134	1.821669	12.13	35.83	182.715	61.878	2.226
2.78																
4th	0.223	0.000120	0.927173	0.617	0.000444	4.855	1.194	2.016	0.579	0.000208	1.448382	10.44	23.69	120.837	53.241	1.915
2.78																
3rd	0.229	0.000124	0.589925	0.887	0.000638	3.350	1.319	1.826	0.378	0.000136	0.869537	7.95	13.25	67.597	40.567	1.459
2.78																
2nd floor	0.240	0.000130	0.240330	1.231	0.000886	1.231	1.381	1.956	0.491	0.000177	0.491434	5.30	5.30	27.030	27.030	0.972
2.78																

	Nail Slip / Ve		
th (inch)	Nail Size / Slip		
3	2	2.5	3
0.23	0.460	0.290	0.230
0.35			
0.49	0.460	0.290	0.230
0.66			
0.86	0.460	0.290	0.230
1.13			
1.48	0.460	0.290	0.230
1.95			
	0.542	0.336	0.263
	0.588	0.363	0.281

Ve	lw total (m)	Ve*lw $_{total}$/lw
259	79	10.5
270	79	10.9
216	79	8.7
162	79	6.6
108	79	4.4
54	79	2.2
1069		

Ae in^2	(.4Ag+.6Ae) in^2	(.4Ag+.6Ae) mm^2	Tr (kN) kN
0.149	0.168	108.3	
0.226	0.258	166.7	42.25
0.334	0.377	243.3	
0.462	0.518	334.0	85.79
0.606	0.678	437.3	
0.763	0.855	551.9	141.96
0.763	0.855	551.9	303.74

Tf*1.2		Tr	Δa HD Slip (m	kN/slip
16.70	2- HDU5	60.00	2.92	25.11
40.12	2-HDU5	60.00	2.90	25.11
73.20	2-HDU8	96.00	2.91	35.01
113.50	2- HDU8	96.00	2.87	35.01
158.64	2- HDU11	125.30	3.48	49.70
206.18	2- HDU14	146.50	4.50	66.30

Appendix C

Results of Representative Wood-Frame Buildings Designed in Accordance with 2006 BCBC

Confidential

C.1 Fundamental period of the Building

	4-storey building (s)				6-storey building (s)			
	With GWB		Without GWB		With GWB		Without GWB	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
Drain-3D	0.54	0.68	0.73	0.78	0.78	0.96	0.99	1.07
SAPWood	0.52		0.64		0.66		0.89	

C.2 Maximum base shear

No.	4-storey building (kN)								6-storey building (kN)							
	Drain-3D				SAPWood				Drain-3D				SAPWood			
	With GWB		Without GWB		With GWB		Without GWB		With GWB		Without GWB		With GWB		Without GWB	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
1	1410	1034	981	882	883	844	1068	959	1711	1632	1384	1409	1031	748	675	543
2	1428	1019	957	889	680	847	1084	581	1679	1660	1552	1379	1137	1078	1131	707
3	1478	1023	961	855	1187	903	991	823	1666	1457	1173	1321	886	937	996	1079
4	1390	1018	979	898	1339	875	1003	771	1687	1577	1413	1507	1297	978	1231	1194
5	1223	1064	985	912	874	782	875	874	1738	1578	1437	1476	815	928	899	856
6	1357	1020	927	944	869	744	887	812	1732	1527	1449	1406	758	903	1060	1099
7	1204	1084	1082	895	708	596	835	639	1763	1599	1437	1355	1137	999	1376	1064
8	1257	1030	945	933	817	1033	907	1049	1642	1578	1553	1393	885	990	1212	1126
9	1468	1052	1035	885	884	810	995	831	1677	1493	1317	1448	989	1011	1089	1107
10	1319	1001	957	855	833	683	555	575	1658	1625	1423	1464	636	674	1025	972
11	1333	955	872	828	971	807	700	669	1451	1744	1525	1531	885	748	718	1030
12	1262	1042	964	921	1309	736	1027	868	1735	1647	1495	1488	1120	951	1273	1063
13	1280	1034	987	921	719	796	808	764	1706	1615	1397	1495	783	778	985	938
14	1405	1000	937	819	929	1084	1231	912	1340	1098	1311	1357	1293	1250	1364	1425
15	1298	1077	1015	908	972	929	1031	792	1721	1507	1425	1375	1161	945	1028	833
16	1323	1021	1003	888	732	720	825	852	1588	1600	1366	1563	712	847	878	892
17	1502	1047	1035	915	615	708	841	920	1755	1485	1288	1377	722	813	905	1083
18	1529	1088	1012	889	1014	752	1026	844	1622	1446	1228	1306	1127	882	932	936
19	1193	1029	935	869	1244	1070	1093	986	1607	1673	1512	1507	1251	1271	1171	1194
20	1366	1095	1057	947	1604	1179	1244	1124	1815	1629	1511	1537	1284	1126	1351	1228
Mean	1351	1037	981	893	959	845	951	832	1665	1559	1410	1435	995	943	1065	1018

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C.3 Maximum displacement and acceleration at each storey

Table C.3.1 Maximum displacements of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	33.8	58.4	72.9	80.0	35.4	56.8	71.9	78.9	24.5	38.7	49.6	52.0
2	34.9	57.7	71.4	78.9	39.6	59.4	72.5	79.0	32.4	50.3	59.7	62.6
3	32.5	57.5	70.9	77.3	34.8	56.2	70.0	76.4	17.0	39.9	57.8	64.5
4	18.1	36.9	54.1	62.4	16.4	32.0	49.7	57.7	20.4	41.1	56.0	62.6
5	24.2	37.5	46.6	53.0	25.5	37.7	45.8	50.0	10.0	19.0	26.0	29.3
6	15.8	29.0	39.8	45.3	15.0	26.5	37.4	42.8	11.0	21.7	30.2	33.6
7	41.0	70.5	84.5	91.7	42.3	68.9	83.1	90.5	31.6	50.2	62.1	65.0
8	24.2	45.1	65.2	74.0	28.5	45.8	65.4	73.1	19.6	42.9	57.9	62.3
9	18.8	33.0	45.3	52.0	21.5	34.1	46.2	52.7	11.0	20.6	28.0	31.2
10	22.0	37.3	48.6	55.7	23.4	36.3	47.8	53.7	10.3	19.6	26.3	29.1
11	37.2	57.0	74.0	83.2	38.7	57.8	71.2	79.4	15.9	31.2	46.6	51.6
12	44.0	68.3	85.6	94.2	46.9	69.8	87.9	96.8	17.4	35.3	49.3	57.4
13	15.8	29.6	42.0	48.6	17.0	29.5	42.0	48.5	10.6	19.1	25.3	27.4
14	24.4	37.1	45.8	50.6	25.6	36.9	46.2	50.9	21.0	31.3	36.5	38.3
15	32.4	54.3	68.1	75.5	31.9	49.1	61.4	67.9	16.6	32.3	45.3	51.1
16	19.1	33.8	45.9	52.6	20.2	33.0	44.1	49.8	10.0	19.0	26.2	28.8
17	26.7	41.5	52.7	59.4	27.4	40.7	51.5	58.4	16.1	27.7	36.2	38.4
18	19.6	35.0	48.2	56.9	21.3	35.7	49.2	56.7	11.5	22.3	33.9	38.4
19	29.4	53.3	71.3	80.0	31.9	51.3	68.6	76.8	16.2	32.1	48.8	51.7
20	27.8	55.7	79.6	88.5	29.8	54.2	78.0	86.9	26.7	48.8	64.4	69.8
Mean	27.1	46.4	60.6	68.0	28.7	45.6	59.5	66.4	17.5	32.2	43.3	47.3

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Table C.3.2 Maximum displacements of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	26.8	54.5	89.5	116.2	26.7	54.5	89.3	115.9	26.6	46.6	62.5	66.8
2	22.8	48.3	73.8	90.8	22.8	48.3	73.7	90.6	32.7	51.3	69.6	72.9
3	22.0	46.3	72.7	90.6	22.0	46.3	72.6	90.4	26.1	50.3	77.3	86.9
4	27.2	45.8	76.6	100.3	27.2	45.8	76.5	100.1	23.0	44.3	67.3	74.9
5	25.5	49.6	76.3	95.7	25.5	49.6	76.3	95.6	17.2	31.9	40.4	43.7
6	29.5	55.3	81.6	102.1	29.4	55.2	81.6	102.1	18.1	35.5	54.5	62.4
7	26.6	59.1	91.4	114.4	26.6	59.0	91.3	114.4	32.9	54.7	69.0	71.1
8	15.2	33.6	58.5	79.9	15.2	33.7	58.6	80.0	16.8	36.0	52.6	57.7
9	27.3	54.2	82.2	101.5	27.3	54.1	82.0	101.2	24.1	41.6	56.6	59.2
10	28.7	54.3	78.2	95.1	28.7	54.2	78.2	95.1	20.7	36.7	47.5	49.9
11	31.3	62.0	92.3	114.6	31.3	61.9	92.2	114.5	27.0	45.0	63.1	67.6
12	38.0	70.3	99.7	119.4	37.9	70.1	99.4	119.0	25.8	44.6	69.7	78.7
13	25.2	42.9	61.8	76.0	25.2	42.8	61.7	75.8	17.1	31.6	47.3	53.0
14	29.4	47.3	64.1	75.8	29.4	47.2	64.0	75.6	30.5	48.5	62.2	64.6
15	24.2	47.2	73.1	92.0	24.2	47.3	73.1	92.0	26.0	48.0	74.0	81.0
16	24.5	44.3	65.2	81.0	24.5	44.3	65.2	80.9	15.3	27.1	40.7	47.1
17	21.1	38.2	57.3	71.4	21.1	38.2	57.2	71.3	16.9	32.7	48.9	54.9
18	26.0	47.2	66.5	80.5	26.0	47.2	66.4	80.3	18.1	33.5	47.6	51.5
19	16.7	36.2	60.5	79.3	16.7	36.1	60.4	79.1	17.9	27.9	45.6	49.3
20	28.8	55.1	84.5	105.7	28.9	55.2	84.6	105.8	26.6	50.5	68.9	75.4
Mean	25.8	49.6	75.3	94.1	25.8	49.6	75.2	94.0	23.0	40.9	58.3	63.4

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Table C.3.3 Maximum displacements of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	20.6	41.4	62.8	87.4	110.3	122.7	18.8	36.7	67.5	91.2	113.1	125.2	14.0	28.5	43.5	56.6	67.2	71.8
2	17.0	33.9	52.2	69.7	86.3	96.8	17.6	33.4	54.3	69.0	85.9	96.8	16.0	32.2	46.5	57.1	65.7	69.6
3	18.4	36.4	56.4	74.3	89.8	99.4	17.8	34.8	60.7	77.7	92.7	102.4	16.3	28.8	45.4	63.1	78.5	84.2
4	20.7	40.4	67.6	93.2	115.9	127.7	20.5	37.0	70.8	95.1	116.7	128.1	14.1	27.4	42.6	55.2	66.6	72.4
5	21.8	43.0	64.1	82.6	98.2	108.2	22.2	39.6	63.1	79.7	94.4	104.1	12.3	22.9	33.3	40.7	47.2	50.2
6	23.7	45.8	65.9	83.3	97.6	107.0	22.3	40.2	61.4	77.7	92.4	102.2	11.5	22.5	32.6	41.5	50.0	54.8
7	18.0	37.5	63.4	86.8	106.8	118.4	17.2	35.0	64.9	84.7	102.4	114.2	17.6	32.8	48.8	61.3	70.2	74.8
8	12.3	26.2	44.8	66.0	87.7	100.4	12.9	27.1	45.8	64.8	86.1	98.9	10.3	22.0	34.8	45.5	54.1	58.5
9	21.3	43.4	68.8	90.6	107.6	117.7	20.9	40.6	71.9	93.1	111.9	123.1	14.5	27.3	40.2	49.2	55.9	59.3
10	18.7	36.7	56.7	74.0	88.7	98.4	20.3	37.1	57.3	72.8	87.3	97.3	12.5	22.5	32.1	39.6	44.7	46.9
11	22.3	45.3	70.4	92.5	111.0	122.3	24.2	43.6	73.3	90.1	105.2	117.4	16.3	30.4	44.3	54.7	63.0	66.5
12	21.4	44.4	68.3	87.7	103.8	114.0	21.8	42.4	71.1	89.0	105.1	115.9	17.3	32.6	47.1	59.6	68.8	73.0
13	16.8	32.7	50.1	65.5	79.1	87.5	14.8	29.5	46.1	60.2	73.2	81.6	11.5	21.4	32.5	41.2	48.0	52.2
14	24.7	42.3	58.5	71.5	80.9	87.4	23.9	40.6	57.4	69.8	79.6	86.7	20.2	33.0	43.5	51.1	56.2	59.2
15	19.3	38.2	58.0	76.9	94.8	105.7	16.6	33.0	56.3	74.1	92.0	103.7	14.2	29.8	45.0	58.1	72.2	78.1
16	17.1	35.0	57.2	77.7	94.9	105.1	16.6	32.9	58.6	77.6	94.9	105.3	10.4	20.0	29.6	37.8	44.8	47.5
17	17.2	32.6	48.5	61.3	71.8	79.5	16.2	30.5	44.9	56.4	66.0	72.5	10.4	21.4	31.0	37.9	45.3	48.8
18	18.2	35.5	53.4	71.8	89.9	101.2	18.8	35.9	56.5	71.8	86.3	96.0	10.1	19.8	29.7	37.5	43.7	46.8
19	11.9	24.8	38.0	52.0	68.3	77.9	12.2	25.4	39.3	52.4	70.6	80.8	10.0	19.4	30.0	39.6	49.5	52.4
20	16.1	34.9	58.0	79.5	98.4	109.9	16.5	34.7	59.9	80.3	99.7	111.8	15.0	30.2	46.4	59.3	68.7	73.0
Mean	18.9	37.5	58.2	77.2	94.1	104.4	18.6	35.5	59.1	76.4	92.8	103.2	13.7	26.3	39.0	49.3	58.0	62.0

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Table C.3.4 Maximum displacements of 6-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	23.7	46.6	69.0	92.0	114.5	131.6	23.7	46.5	69.0	91.9	114.5	131.6	18.1	32.2	45.3	64.6	77.7	81.5
2	16.3	29.8	40.0	59.6	91.5	117.2	16.3	29.7	39.8	59.4	91.1	116.7	14.6	32.4	46.5	60.5	73.2	76.0
3	25.6	43.6	59.0	86.2	121.7	147.9	25.6	43.6	58.9	86.0	121.3	147.4	25.4	43.8	62.3	81.7	111.8	121.7
4	20.5	41.3	61.7	83.4	110.5	140.0	20.5	41.3	61.8	83.4	110.5	139.9	22.2	38.4	50.4	61.2	81.1	87.8
5	19.9	42.5	68.1	107.7	150.3	184.8	19.9	42.5	68.1	107.6	150.1	184.7	13.7	25.1	35.5	46.1	57.8	61.3
6	25.1	52.1	81.6	115.5	148.3	176.2	25.1	52.0	81.4	115.2	148.1	176.1	17.0	33.4	45.4	58.4	74.1	79.9
7	20.9	37.8	53.1	75.0	102.7	125.8	20.8	37.8	53.0	74.9	102.8	125.9	23.1	42.8	57.9	69.4	77.4	79.4
8	32.8	54.2	74.9	101.1	128.4	152.4	32.8	54.1	74.8	100.9	128.0	151.8	17.0	31.0	46.1	59.3	66.1	66.8
9	29.8	56.1	81.8	113.9	146.7	172.3	29.8	56.0	81.7	113.4	146.1	171.6	22.2	37.2	52.0	65.5	75.8	78.2
10	18.6	38.1	61.6	100.6	144.5	178.4	18.5	37.9	61.5	100.5	144.1	178.0	15.3	27.8	40.3	49.5	55.8	57.6
11	20.1	37.5	59.7	91.7	124.6	149.0	20.0	37.3	59.8	91.7	124.5	148.8	14.0	30.1	44.9	60.5	73.2	76.1
12	14.9	29.1	41.3	59.0	79.6	96.7	14.9	29.0	41.3	58.9	79.5	96.4	18.5	33.8	47.3	56.7	71.8	77.7
13	29.9	59.9	92.9	131.4	168.5	199.8	29.8	59.8	92.7	131.2	168.4	199.7	18.0	32.2	44.9	60.5	77.5	83.7
14	27.9	50.6	71.6	95.4	127.9	150.9	27.9	50.5	71.5	95.2	127.6	150.4	26.5	41.5	52.2	62.4	69.9	73.1
15	20.7	43.9	70.3	104.6	141.0	168.7	20.7	43.8	70.2	104.3	140.6	168.2	22.2	40.4	56.7	75.9	93.4	98.8
16	23.7	48.7	78.1	113.9	148.7	176.4	23.7	48.6	78.0	113.9	148.6	176.3	15.1	28.1	41.5	52.5	62.2	64.2
17	26.8	47.0	72.1	113.7	155.2	187.1	26.8	46.9	71.9	113.4	154.7	186.5	15.4	30.9	44.3	58.5	72.4	78.1
18	20.4	40.8	65.1	97.5	131.6	159.5	20.4	40.8	65.0	97.3	131.4	159.3	12.6	22.9	33.0	41.8	54.6	57.0
19	12.0	20.4	26.4	38.5	56.7	78.7	12.0	20.3	26.4	38.4	56.8	78.9	16.4	28.9	35.7	43.0	49.9	52.3
20	30.8	49.0	63.0	75.1	98.4	127.5	30.8	49.0	63.0	74.9	98.1	127.0	25.4	43.6	55.1	54.9	68.3	72.8
Mean	23.0	43.4	64.6	92.8	124.6	151.0	23.0	43.4	64.5	92.6	124.3	150.8	18.6	33.8	46.9	59.1	72.2	76.2

Table C.3.5 Maximum displacements of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	28.1	55.8	81.8	93.6	29.5	51.3	84.6	95.9	25.6	48.1	70.1	77.6
2	27.5	52.4	80.1	87.9	29.7	50.3	79.7	86.2	26.0	48.5	69.1	75.3
3	27.4	50.9	80.3	87.3	29.9	44.4	80.0	87.3	23.1	46.8	74.0	88.6
4	30.4	46.6	74.5	84.1	30.3	42.5	76.9	86.7	22.7	41.3	65.3	80.7
5	20.3	39.2	63.1	71.6	21.7	38.7	62.5	70.5	15.2	32.2	46.2	54.3
6	39.5	55.5	71.2	78.5	42.0	56.6	72.7	79.9	16.9	35.7	52.5	62.3
7	32.9	64.7	84.0	91.0	36.1	62.7	82.8	89.5	30.4	60.4	79.5	88.3
8	13.5	29.4	63.0	74.1	13.4	25.1	63.3	72.9	15.7	31.1	52.7	61.4
9	25.5	48.3	73.9	82.3	26.3	44.4	73.2	80.3	21.8	40.3	59.3	67.4
10	34.0	58.3	74.5	81.9	31.9	53.1	70.9	77.8	23.2	39.1	50.4	57.4
11	34.4	61.6	77.5	86.2	37.6	61.3	77.7	85.0	29.3	49.0	70.4	84.7
12	38.5	67.3	92.8	100.5	30.3	58.8	91.5	98.6	23.9	50.2	74.3	89.5
13	22.4	41.3	57.6	65.4	22.9	36.8	61.1	67.0	15.1	30.9	49.0	60.8
14	37.0	51.9	64.2	70.8	38.1	51.4	64.1	69.6	28.8	45.2	61.6	67.7
15	24.6	46.4	73.5	82.9	27.1	45.7	75.4	83.8	24.1	45.2	72.6	85.1
16	21.9	39.0	56.0	64.8	22.4	37.4	56.1	64.1	15.7	28.6	44.8	52.9
17	28.3	45.5	59.9	67.6	25.6	40.0	61.8	70.9	16.8	34.1	52.0	60.8
18	25.8	44.5	58.1	68.1	30.6	43.9	57.8	66.2	15.6	32.0	48.0	56.8
19	16.9	31.4	62.5	73.9	18.8	28.0	65.0	76.6	16.6	33.5	50.7	55.7
20	32.7	61.4	90.4	98.4	32.1	54.4	88.1	95.7	24.3	46.6	74.2	82.1
Mean	28.1	49.6	71.9	80.5	28.8	46.3	72.3	80.2	21.5	40.9	60.8	70.5

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Table C.3.6 Maximum displacements of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	30.3	56.4	90.5	118.6	30.3	56.4	90.4	118.4	29.7	48.2	67.1	74.9
2	22.7	46.5	78.5	100.2	22.7	46.5	78.5	100.2	29.2	51.0	73.7	77.0
3	29.0	53.4	82.6	100	29.0	53.4	82.6	99.9	38.3	56.6	97.4	111.2
4	34.0	55.4	86.9	107.8	34.0	55.4	86.8	107.7	32.4	48.8	77.6	90.0
5	39.0	70.1	100.9	123.5	38.9	70.0	100.7	123.3	21.0	39.8	59.7	61.8
6	30.9	58.1	84.2	102.9	30.9	58.1	84.2	102.8	19.7	37.5	62.1	72.0
7	29.1	54.3	90.7	112.1	29.1	54.3	90.8	112.1	36.0	54.4	73.2	76.8
8	18.3	38.2	71.6	95.1	18.3	38.2	71.6	95.1	23.5	44.5	63.3	69.9
9	33.1	59.8	90.5	113.1	33.1	59.7	90.6	113.2	33.4	51.7	73.2	77.2
10	30.7	58.0	91.1	117.5	30.7	58.0	91.1	117.5	27.7	44.3	56.8	60.8
11	35.2	66.5	96.8	121.6	35.1	66.3	96.7	121.5	22.6	45.9	64.8	71.7
12	30.8	60.2	90.7	108.4	30.8	60.1	90.4	108.1	26.9	44.7	70.2	80.7
13	23.3	40.2	61.9	77.6	23.3	40.2	61.8	77.6	22.5	39.3	67.1	80.1
14	35.1	54.4	77.0	94.7	35.1	54.4	76.9	94.6	37.8	54.3	70.6	79.8
15	28.2	49.0	74.7	93.3	28.3	49.1	74.7	93.3	29.2	55.6	84.2	95.4
16	34.5	61.9	90.9	117.1	34.4	61.8	90.8	117.0	20.1	39.0	59.8	61.3
17	22.7	37.4	54.5	66.5	22.7	37.3	54.6	66.6	19.4	36.9	58.4	65.7
18	30.2	51.9	77.7	99.7	30.2	52.0	77.8	99.8	19.5	36.7	55.1	60.8
19	14.3	29.7	53.1	84.9	14.3	29.8	53.2	84.7	24.8	34.7	41.6	44.2
20	28.8	56.3	90.4	114.8	28.8	56.4	90.5	114.8	32.8	41.4	62.3	69.8
Mean	29.0	52.9	81.8	103.7	29.0	52.9	81.7	103.4	27.3	45.3	66.9	74.0

Table C.3.7 Maximum displacements of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	21.0	43.5	66.3	85.5	112.0	121.3	22.0	39.1	67.3	84.4	103.4	111.2	21.5	33.0	48.3	63.3	78.7	86.3
2	13.2	26.2	42.9	63.8	87.8	100.0	12.4	24.0	43.5	63.2	87.2	98.6	15.0	28.6	45.2	62.6	76.4	81.3
3	22.5	41.2	60.0	74.6	107.1	119.7	22.6	38.8	63.8	78.5	118.4	131.0	24.6	43.6	64.7	84.0	114.9	132.4
4	25.2	49.2	72.1	88.2	102.7	112.8	26.1	43.5	70.9	85.4	101.1	112.8	22.3	41.1	55.4	66.1	79.2	87.4
5	35.2	66.9	97.0	114.9	133.1	142.6	28.9	50.2	89.2	108.3	133.9	144.9	14.1	25.6	41.4	55.6	68.9	73.4
6	29.6	58.0	83.3	99.4	113.3	121.7	26.4	45.4	75.6	90.2	108.5	119.8	14.8	29.8	47.6	61.7	79.8	89.5
7	16.1	33.6	55.7	74.6	99.0	109.3	15.9	32.0	58.0	75.3	93.2	103.0	18.7	37.8	56.9	70.4	80.7	86.1
8	32.0	54.0	71.0	86.4	101.2	111.3	33.7	50.4	68.2	81.7	96.3	106.3	17.2	33.8	51.2	65.1	72.2	74.7
9	35.0	64.7	89.7	106.3	120.3	131.9	32.7	54.0	89.5	107.8	129.1	141.4	27.6	42.7	61.0	71.0	85.4	96.2
10	28.2	51.0	71.9	88.2	104.7	111.1	24.2	42.1	71.3	89.6	117.7	128.7	14.8	28.7	43.7	55.4	64.5	69.2
11	15.9	34.9	59.3	83.4	118.1	131.0	13.9	30.2	55.5	75.7	110.4	122.3	12.3	25.5	41.4	59.0	73.6	84.0
12	15.9	31.2	48.7	68.5	89.2	98.8	15.6	30.5	50.1	70.1	97.2	107.5	14.6	29.0	44.4	57.0	69.5	75.8
13	37.1	69.4	99.3	120.4	141.1	151.5	32.0	54.7	91.8	111.3	137.9	148.1	21.8	38.6	57.0	72.6	87.7	97.6
14	33.1	57.2	81.9	99.1	118.9	127.0	33.0	52.9	81.9	99.3	118.4	127.1	22.5	39.1	53.4	66.3	77.5	85.4
15	39.7	74.3	106.4	127.5	148.5	157.8	36.8	60.4	102.4	122.0	142.2	151.3	17.9	36.4	58.9	78.1	94.0	102.8
16	35.4	64.1	85.0	98.2	109.9	118.4	35.5	56.1	83.2	95.8	109.0	119.7	15.8	31.1	42.1	54.2	63.6	68.8
17	27.5	49.8	71.9	91.8	111.0	121.6	23.4	41.0	69.5	86.4	109.1	118.7	14.5	31.9	50.6	65.5	81.7	90.9
18	20.5	39.6	65.6	86.9	109.4	119.9	21.8	36.6	65.9	83.2	103.6	113.7	12.8	23.3	33.7	44.8	54.6	57.4
19	14.8	25.2	33.4	45.8	59.0	66.5	14.8	25.4	33.0	43.7	62.7	70.3	12.6	23.5	33.8	41.2	46.7	50.7
20	31.6	52.2	70.0	84.9	95.5	108.9	31.3	49.5	72.0	85.8	92.3	103.5	22.3	40.8	47.4	53.4	67.7	72.1
Mean	26.5	49.3	71.6	89.4	109.1	119.2	25.2	42.8	70.1	86.9	108.6	119.0	17.9	33.2	48.9	62.4	75.9	83.1

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Table C.3.8 Maximum displacements of 6-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	22.0	44.5	67.6	92.0	121.1	138.5	21.9	44.5	67.6	92.0	121.2	138.6	20.9	35.0	48.3	62.7	74.4	83.2
2	16.5	31.0	42.8	54.5	80.7	107.1	16.5	31.0	42.7	54.4	80.7	106.8	16.1	31.6	44.5	58.4	77.2	80.1
3	28.2	49.1	65.7	92.1	131.6	160.9	28.2	49.0	65.5	91.8	131.3	160.5	30.8	54.4	75.6	101.2	137.7	150.9
4	23.4	43.6	65.6	90.9	117.9	139.2	23.4	43.5	65.6	90.9	118.0	139.3	17.9	37.2	53.6	71.5	97.3	105.9
5	19.0	38.3	60.1	86.5	112.2	135.9	18.8	38.4	60.3	86.5	112.3	136.2	15.0	29.4	42.1	53.4	68.6	74.2
6	21.4	43.9	69.3	103.8	148.2	185.2	21.4	43.7	69.0	103.5	147.8	184.8	20.3	36.0	49.1	61.2	77.2	83.1
7	24.4	42.1	57.1	75.7	101.3	122.3	24.4	42.0	57.1	75.6	101.2	122.5	21.7	41.5	58.1	73.2	88.4	91.9
8	28.9	49.2	75.2	109.0	143.9	170.1	28.9	49.2	75.1	108.9	143.6	169.7	19.3	38.5	56.1	65.8	70.4	71.9
9	29.6	54.3	78.6	113.9	146.5	169.9	29.6	54.3	78.7	113.7	146.1	169.4	25.8	47.0	63.9	79.8	90.3	98.4
10	21.3	42.1	64.6	102.4	149.4	185.8	21.2	42.0	64.3	101.7	148.5	184.6	15.2	30.3	46.4	58.4	69.0	72.4
11	26.1	44.8	61.9	87.8	124.9	150.7	26.0	44.7	61.8	87.7	124.8	150.4	16.1	30.5	43.8	66.4	82.7	88.0
12	15.6	31.2	45.2	57.3	73.7	92.5	15.6	31.0	45.0	57.0	73.4	92.0	16.2	28.7	41.9	58.1	73.5	79.1
13	31.3	61.3	95.1	138.4	180.7	213.9	31.2	61.1	94.8	138.1	180.3	213.4	24.1	47.6	63.5	81.0	101.3	108.1
14	27.5	50.9	73.4	105.5	146.4	171.6	27.6	50.9	73.4	105.4	146.1	171.2	27.9	46.1	61.4	77.1	94.8	99.6
15	18.9	36.2	52.5	75.6	113.9	148.1	18.9	36.3	52.6	75.0	113.4	147.4	22.0	40.9	58.0	83.4	101.2	109.1
16	22.2	46.5	74.9	113.4	151.8	180.8	22.0	46.2	74.5	112.7	150.9	179.7	15.0	29.6	40.1	49.4	59.7	65.3
17	22.1	44.6	67.7	99.0	145.5	185.3	22.0	44.4	67.4	98.2	144.4	184.4	14.8	30.7	43.8	63.2	78.1	85.2
18	26.1	46.9	66.9	90.5	113.7	132.4	26.0	46.9	66.7	90.3	113.4	131.9	13.9	28.2	40.7	50.9	64.7	70.3
19	16.0	26.7	32.4	34.4	61.3	85.4	16.0	26.7	32.3	34.4	61.1	85.0	19.6	32.9	40.7	44.0	49.3	49.8
20	36.7	58.8	72.5	78.2	90.1	117.0	36.7	58.7	72.5	78.2	89.9	116.8	23.2	40.2	51.3	68.0	65.7	69.7
Mean	23.9	44.3	64.5	90.0	122.7	149.6	23.8	44.2	64.3	89.8	122.4	149.2	19.8	36.8	51.1	66.4	81.1	86.8

Table C.3.9 Maximum accelerations of 4-storey building, (g)

No.	SAPWood															
	With GWB								Without GWB							
	E-W				N-S				E-W				N-S			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	0.32	0.31	0.37	0.39	0.34	0.35	0.28	0.35	0.44	0.45	0.34	0.41	0.38	0.26	0.28	0.33
2	0.26	0.37	0.36	0.38	0.32	0.25	0.28	0.31	0.39	0.37	0.34	0.38	0.20	0.31	0.26	0.26
3	0.42	0.39	0.46	0.54	0.37	0.42	0.33	0.46	0.37	0.42	0.43	0.55	0.41	0.37	0.35	0.48
4	0.44	0.42	0.41	0.44	0.31	0.35	0.30	0.39	0.33	0.35	0.35	0.50	0.28	0.27	0.25	0.38
5	0.28	0.26	0.25	0.27	0.32	0.29	0.24	0.27	0.32	0.32	0.28	0.36	0.33	0.34	0.27	0.35
6	0.28	0.29	0.28	0.33	0.34	0.35	0.32	0.36	0.34	0.37	0.36	0.45	0.34	0.35	0.30	0.40
7	0.29	0.34	0.40	0.41	0.20	0.27	0.27	0.27	0.27	0.30	0.34	0.37	0.26	0.20	0.26	0.30
8	0.31	0.32	0.42	0.47	0.33	0.29	0.28	0.34	0.36	0.26	0.34	0.39	0.43	0.38	0.24	0.31
9	0.31	0.29	0.26	0.28	0.33	0.29	0.27	0.27	0.34	0.31	0.29	0.38	0.40	0.37	0.25	0.31
10	0.27	0.25	0.27	0.27	0.27	0.24	0.23	0.26	0.17	0.29	0.28	0.36	0.22	0.26	0.25	0.30
11	0.29	0.42	0.39	0.51	0.30	0.34	0.31	0.41	0.24	0.31	0.40	0.56	0.29	0.29	0.28	0.41
12	0.40	0.38	0.38	0.44	0.23	0.35	0.32	0.39	0.30	0.38	0.32	0.47	0.32	0.30	0.30	0.42
13	0.23	0.23	0.24	0.28	0.34	0.32	0.27	0.34	0.35	0.38	0.34	0.42	0.40	0.37	0.30	0.43
14	0.36	0.34	0.29	0.39	0.39	0.30	0.25	0.28	0.38	0.38	0.33	0.36	0.30	0.27	0.26	0.36
15	0.36	0.38	0.39	0.45	0.42	0.43	0.32	0.40	0.46	0.45	0.35	0.47	0.40	0.42	0.30	0.42
16	0.21	0.24	0.23	0.27	0.28	0.27	0.27	0.31	0.29	0.31	0.34	0.40	0.33	0.35	0.28	0.37
17	0.20	0.26	0.31	0.33	0.30	0.28	0.29	0.33	0.29	0.27	0.26	0.37	0.31	0.31	0.25	0.33
18	0.34	0.29	0.32	0.41	0.33	0.30	0.29	0.37	0.32	0.30	0.33	0.42	0.31	0.32	0.27	0.37
19	0.49	0.42	0.39	0.47	0.42	0.31	0.31	0.33	0.46	0.48	0.35	0.47	0.46	0.40	0.26	0.29
20	0.46	0.35	0.43	0.51	0.46	0.34	0.32	0.40	0.51	0.46	0.34	0.38	0.57	0.46	0.26	0.33
Mean	0.33	0.33	0.34	0.39	0.33	0.32	0.29	0.34	0.35	0.36	0.34	0.42	0.35	0.33	0.27	0.36

Note:
The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

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Table C.3.10 Maximum accelerations of 6-storey building, (g)

No.	SAPWood																							
	With GWB												Without GWB											
	E-W						E-W						E-W						E-W					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.33	0.29	0.38	0.34	0.33	0.40	0.22	0.27	0.22	0.30	0.26	0.32	0.24	0.23	0.22	0.28	0.30	0.35	0.23	0.21	0.21	0.24	0.29	0.37
2	0.31	0.28	0.26	0.28	0.34	0.37	0.27	0.21	0.25	0.24	0.27	0.30	0.28	0.25	0.21	0.32	0.32	0.35	0.24	0.24	0.22	0.22	0.27	0.28
3	0.31	0.35	0.39	0.41	0.39	0.47	0.32	0.34	0.31	0.40	0.37	0.49	0.31	0.34	0.34	0.38	0.43	0.62	0.50	0.39	0.36	0.31	0.36	0.50
4	0.40	0.36	0.32	0.30	0.31	0.36	0.33	0.31	0.24	0.27	0.26	0.35	0.36	0.30	0.32	0.23	0.29	0.39	0.45	0.32	0.27	0.30	0.29	0.33
5	0.23	0.26	0.28	0.26	0.24	0.31	0.29	0.23	0.23	0.28	0.26	0.31	0.26	0.27	0.26	0.30	0.30	0.39	0.27	0.27	0.28	0.25	0.25	0.34
6	0.24	0.27	0.31	0.28	0.28	0.36	0.31	0.23	0.23	0.29	0.30	0.35	0.28	0.30	0.29	0.34	0.36	0.44	0.34	0.22	0.29	0.27	0.26	0.35
7	0.32	0.26	0.29	0.34	0.32	0.40	0.28	0.21	0.23	0.26	0.25	0.26	0.36	0.29	0.20	0.30	0.29	0.35	0.27	0.21	0.24	0.21	0.27	0.30
8	0.32	0.28	0.22	0.26	0.32	0.34	0.37	0.32	0.27	0.30	0.25	0.32	0.39	0.42	0.29	0.32	0.29	0.42	0.33	0.36	0.36	0.31	0.23	0.32
9	0.30	0.25	0.21	0.25	0.28	0.31	0.36	0.24	0.26	0.34	0.28	0.36	0.37	0.28	0.34	0.30	0.31	0.46	0.41	0.19	0.21	0.22	0.24	0.33
10	0.15	0.19	0.19	0.21	0.23	0.24	0.17	0.15	0.17	0.19	0.18	0.21	0.25	0.17	0.19	0.21	0.21	0.23	0.25	0.20	0.22	0.19	0.22	0.25
11	0.25	0.23	0.31	0.28	0.29	0.33	0.26	0.21	0.19	0.28	0.29	0.36	0.21	0.26	0.27	0.30	0.31	0.47	0.25	0.22	0.29	0.33	0.25	0.30
12	0.29	0.29	0.27	0.34	0.32	0.36	0.30	0.26	0.23	0.28	0.28	0.38	0.36	0.31	0.24	0.26	0.28	0.36	0.28	0.27	0.26	0.31	0.25	0.36
13	0.25	0.26	0.31	0.30	0.27	0.34	0.26	0.24	0.29	0.41	0.33	0.42	0.27	0.33	0.29	0.31	0.34	0.44	0.32	0.24	0.26	0.32	0.30	0.33
14	0.40	0.45	0.36	0.28	0.26	0.29	0.34	0.30	0.31	0.29	0.24	0.26	0.39	0.39	0.37	0.31	0.28	0.38	0.36	0.33	0.34	0.32	0.27	0.32
15	0.34	0.39	0.38	0.35	0.38	0.44	0.33	0.33	0.41	0.41	0.32	0.41	0.32	0.41	0.46	0.42	0.34	0.48	0.30	0.33	0.35	0.33	0.26	0.36
16	0.20	0.22	0.22	0.24	0.25	0.27	0.31	0.26	0.33	0.33	0.25	0.28	0.26	0.24	0.32	0.32	0.27	0.37	0.24	0.22	0.21	0.24	0.24	0.29
17	0.22	0.22	0.25	0.23	0.24	0.27	0.28	0.27	0.30	0.33	0.30	0.37	0.25	0.31	0.37	0.36	0.31	0.42	0.31	0.33	0.34	0.25	0.27	0.37
18	0.26	0.28	0.31	0.27	0.27	0.35	0.28	0.22	0.23	0.27	0.24	0.30	0.28	0.30	0.26	0.23	0.24	0.36	0.31	0.28	0.30	0.24	0.23	0.34
19	0.39	0.35	0.28	0.26	0.32	0.36	0.39	0.36	0.33	0.28	0.26	0.37	0.57	0.47	0.32	0.25	0.32	0.45	0.44	0.41	0.42	0.36	0.24	0.31
20	0.53	0.42	0.30	0.34	0.35	0.40	0.44	0.52	0.55	0.31	0.29	0.37	0.61	0.53	0.38	0.35	0.37	0.40	0.48	0.42	0.48	0.39	0.28	0.32

Note:

The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

C.4 Maximum inter-storey drift

Table C.4.1 Inter-storey drift of 4-storey building in E-W direction (with GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.23	0.90	0.67	0.31	1.29	0.78	0.69	0.33	0.89	0.52	0.40	0.13
2	1.27	0.87	0.61	0.30	1.44	0.76	0.63	0.31	1.18	0.66	0.35	0.14
3	1.18	0.91	0.51	0.25	1.27	0.78	0.52	0.27	0.62	0.84	0.68	0.25
4	0.66	0.69	0.67	0.32	0.60	0.57	0.70	0.33	0.74	0.86	0.68	0.27
5	0.88	0.52	0.46	0.27	0.93	0.47	0.44	0.26	0.36	0.41	0.31	0.13
6	0.57	0.48	0.41	0.22	0.54	0.44	0.41	0.22	0.40	0.40	0.37	0.16
7	1.49	1.09	0.53	0.27	1.54	0.98	0.52	0.27	1.15	0.68	0.45	0.13
8	0.88	0.99	0.75	0.34	1.04	0.85	0.72	0.34	0.71	0.87	0.62	0.18
9	0.68	0.54	0.45	0.25	0.78	0.46	0.44	0.24	0.40	0.42	0.30	0.12
10	0.80	0.55	0.51	0.30	0.85	0.51	0.49	0.28	0.37	0.39	0.31	0.12
11	1.35	0.80	0.63	0.34	1.41	0.72	0.61	0.30	0.58	0.57	0.59	0.27
12	1.60	0.95	0.63	0.33	1.70	0.89	0.66	0.34	0.63	0.72	0.55	0.31
13	0.57	0.51	0.45	0.24	0.62	0.46	0.47	0.24	0.39	0.35	0.24	0.10
14	0.89	0.46	0.47	0.29	0.93	0.42	0.46	0.27	0.76	0.44	0.43	0.22
15	1.18	0.83	0.57	0.30	1.16	0.64	0.58	0.29	0.60	0.60	0.56	0.21
16	0.70	0.54	0.46	0.25	0.73	0.48	0.47	0.24	0.36	0.35	0.31	0.11
17	0.97	0.54	0.41	0.24	1.00	0.48	0.41	0.25	0.59	0.43	0.31	0.13
18	0.71	0.60	0.54	0.31	0.78	0.55	0.58	0.31	0.42	0.40	0.44	0.23
19	1.07	0.87	0.66	0.32	1.16	0.71	0.66	0.32	0.59	0.73	0.75	0.30
20	1.01	1.05	0.87	0.38	1.08	0.91	0.87	0.38	0.97	0.81	0.59	0.20
Mean	0.98	0.73	0.56	0.29	1.04	0.64	0.57	0.29	0.64	0.57	0.46	0.19

Note:
Storey height = 2750 mm

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Table C.4.2 Inter-storey drift of 4-storey building in N-S direction (with GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	0.97	1.14	1.34	0.98	0.97	1.14	1.33	0.98	0.97	0.81	0.79	0.28
2	0.83	0.94	0.99	0.68	0.83	0.94	0.99	0.68	1.19	0.76	0.75	0.19
3	0.80	0.90	0.98	0.72	0.80	0.90	0.98	0.72	0.95	0.91	1.07	0.35
4	0.99	0.90	1.14	0.86	0.99	0.90	1.14	0.86	0.84	0.81	0.96	0.28
5	0.93	0.89	0.99	0.74	0.93	0.89	0.99	0.74	0.63	0.68	0.55	0.22
6	1.07	0.96	0.97	0.76	1.07	0.96	0.97	0.76	0.66	0.72	0.77	0.30
7	0.97	1.19	1.17	0.86	0.97	1.19	1.17	0.86	1.20	0.80	0.55	0.11
8	0.55	0.72	1.04	0.78	0.55	0.73	1.04	0.78	0.61	0.70	0.81	0.21
9	0.99	1.01	1.02	0.70	0.99	1.00	1.01	0.70	0.88	0.67	0.56	0.13
10	1.05	0.94	0.97	0.74	1.04	0.94	0.97	0.74	0.75	0.63	0.56	0.20
11	1.14	1.15	1.13	0.82	1.14	1.14	1.12	0.82	0.98	0.76	0.88	0.29
12	1.38	1.21	1.10	0.86	1.38	1.21	1.10	0.86	0.94	0.71	0.99	0.39
13	0.92	0.67	0.70	0.52	0.92	0.67	0.70	0.51	0.62	0.67	0.63	0.23
14	1.07	0.72	0.69	0.56	1.07	0.72	0.68	0.56	1.11	0.76	0.67	0.29
15	0.88	0.87	0.98	0.72	0.88	0.87	0.98	0.72	0.95	0.83	1.16	0.25
16	0.89	0.74	0.80	0.59	0.89	0.74	0.80	0.59	0.56	0.57	0.58	0.26
17	0.77	0.65	0.72	0.51	0.77	0.65	0.72	0.51	0.61	0.67	0.60	0.28
18	0.95	0.78	0.81	0.71	0.95	0.78	0.81	0.71	0.66	0.61	0.76	0.28
19	0.61	0.73	1.09	0.84	0.61	0.73	1.10	0.84	0.65	0.65	0.87	0.29
20	1.05	1.03	1.16	0.82	1.05	1.03	1.16	0.82	0.97	0.91	0.79	0.29
Mean	0.94	0.91	0.99	0.74	0.94	0.91	0.99	0.74	0.84	0.73	0.77	0.26

Note:
Storey height = 2750 mm

Table C.4.3 Inter-storey drift of 6-storey building in E-W direction (with GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.75	0.77	0.98	0.92	0.84	0.47	0.68	0.66	1.26	0.88	0.80	0.45	0.51	0.55	0.63	0.53	0.48	0.19
2	0.62	0.62	0.79	0.75	0.66	0.39	0.64	0.60	0.88	0.68	0.64	0.40	0.58	0.62	0.63	0.45	0.32	0.16
3	0.67	0.67	0.75	0.69	0.70	0.70	0.65	0.63	0.95	0.64	0.65	0.42	0.59	0.49	0.61	0.71	0.61	0.21
4	0.75	0.79	0.99	0.93	0.84	0.47	0.74	0.70	1.23	0.88	0.82	0.47	0.51	0.59	0.60	0.52	0.43	0.21
5	0.79	0.78	0.77	0.67	0.57	0.37	0.81	0.64	0.87	0.61	0.54	0.35	0.45	0.43	0.42	0.35	0.32	0.17
6	0.86	0.81	0.74	0.68	0.64	0.41	0.81	0.65	0.79	0.63	0.66	0.41	0.42	0.43	0.43	0.38	0.39	0.20
7	0.65	0.73	0.95	0.85	0.73	0.43	0.63	0.68	1.09	0.72	0.65	0.43	0.64	0.62	0.73	0.47	0.36	0.17
8	0.45	0.54	0.74	0.84	0.84	0.47	0.47	0.55	0.79	0.75	0.82	0.47	0.37	0.44	0.52	0.54	0.37	0.19
9	0.77	0.83	0.93	0.79	0.63	0.39	0.76	0.72	1.19	0.77	0.70	0.44	0.53	0.48	0.47	0.33	0.25	0.13
10	0.68	0.68	0.73	0.66	0.55	0.35	0.74	0.61	0.81	0.59	0.55	0.37	0.45	0.37	0.36	0.27	0.20	0.12
11	0.81	0.88	0.98	0.83	0.67	0.42	0.88	0.79	1.11	0.73	0.68	0.44	0.59	0.61	0.53	0.45	0.32	0.14
12	0.78	0.86	0.89	0.72	0.69	0.43	0.79	0.75	1.07	0.68	0.62	0.39	0.63	0.56	0.55	0.49	0.45	0.23
13	0.61	0.59	0.66	0.59	0.50	0.32	0.54	0.54	0.66	0.52	0.50	0.33	0.42	0.40	0.43	0.38	0.38	0.16
14	0.90	0.68	0.68	0.55	0.49	0.32	0.87	0.63	0.73	0.51	0.50	0.30	0.73	0.56	0.57	0.36	0.32	0.19
15	0.70	0.69	0.75	0.73	0.68	0.43	0.60	0.61	0.86	0.67	0.67	0.43	0.52	0.60	0.60	0.50	0.59	0.22
16	0.62	0.66	0.81	0.74	0.64	0.39	0.60	0.60	0.97	0.69	0.65	0.40	0.38	0.38	0.37	0.32	0.29	0.15
17	0.63	0.57	0.59	0.53	0.47	0.31	0.59	0.53	0.56	0.49	0.46	0.30	0.38	0.40	0.38	0.33	0.27	0.13
18	0.66	0.65	0.70	0.70	0.66	0.41	0.68	0.62	0.82	0.58	0.61	0.39	0.37	0.39	0.39	0.38	0.31	0.17
19	0.43	0.50	0.52	0.62	0.76	0.44	0.44	0.51	0.56	0.61	0.78	0.47	0.36	0.44	0.49	0.49	0.38	0.19
20	0.59	0.70	0.93	0.87	0.73	0.42	0.60	0.67	1.09	0.81	0.74	0.44	0.55	0.60	0.67	0.50	0.46	0.20
Mean	0.69	0.70	0.79	0.73	0.66	0.42	0.68	0.63	0.91	0.67	0.65	0.40	0.50	0.50	0.52	0.44	0.37	0.18

Note:
Storey height = 2750 mm

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Table C.4.4 Inter-storey drift of 6-storey building in N-S direction (with GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.86	0.83	0.82	0.90	1.06	0.82	0.86	0.83	0.82	0.90	1.05	0.81	0.66	0.55	0.67	0.81	0.60	0.15
2	0.59	0.51	0.60	0.89	1.39	1.06	0.59	0.51	0.60	0.88	1.39	1.06	0.53	0.69	0.60	0.64	0.59	0.14
3	0.93	0.69	0.78	1.18	1.42	1.05	0.93	0.68	0.78	1.18	1.42	1.04	0.92	0.72	0.68	0.73	1.33	0.36
4	0.75	0.76	0.77	1.03	1.38	1.10	0.75	0.76	0.77	1.03	1.38	1.10	0.81	0.65	0.64	0.64	0.75	0.25
5	0.72	0.83	1.00	1.49	1.59	1.28	0.72	0.83	1.00	1.49	1.59	1.27	0.50	0.52	0.47	0.43	0.58	0.21
6	0.91	0.98	1.08	1.27	1.25	1.02	0.91	0.98	1.08	1.27	1.25	1.02	0.62	0.63	0.53	0.57	0.60	0.28
7	0.76	0.65	0.74	0.93	1.18	0.92	0.76	0.65	0.73	0.93	1.18	0.92	0.84	0.73	0.61	0.59	0.41	0.10
8	1.19	0.87	0.92	1.17	1.36	0.99	1.19	0.87	0.92	1.16	1.36	0.98	0.62	0.60	0.58	0.65	0.66	0.23
9	1.08	0.96	1.08	1.30	1.24	0.99	1.08	0.96	1.07	1.29	1.23	0.98	0.81	0.64	0.58	0.53	0.62	0.21
10	0.68	0.73	0.91	1.43	1.62	1.29	0.67	0.73	0.90	1.43	1.62	1.28	0.56	0.48	0.47	0.34	0.35	0.13
11	0.73	0.72	0.87	1.17	1.24	1.00	0.73	0.72	0.87	1.17	1.24	0.99	0.51	0.60	0.59	0.57	0.64	0.21
12	0.54	0.54	0.60	0.70	0.84	0.70	0.54	0.54	0.60	0.70	0.84	0.70	0.67	0.61	0.53	0.59	0.68	0.31
13	1.09	1.09	1.20	1.41	1.36	1.14	1.08	1.09	1.20	1.41	1.36	1.14	0.65	0.59	0.52	0.62	0.86	0.33
14	1.01	0.86	0.92	1.21	1.18	0.91	1.01	0.86	0.92	1.20	1.18	0.91	0.96	0.66	0.57	0.63	0.52	0.25
15	0.75	0.86	1.01	1.41	1.41	1.16	0.75	0.86	1.01	1.41	1.41	1.16	0.81	0.67	0.69	0.71	1.04	0.28
16	0.86	0.96	1.07	1.35	1.44	1.15	0.86	0.95	1.07	1.35	1.44	1.15	0.55	0.58	0.56	0.61	0.59	0.25
17	0.98	0.80	1.02	1.54	1.57	1.30	0.97	0.80	1.02	1.53	1.57	1.29	0.56	0.60	0.57	0.64	0.59	0.29
18	0.74	0.79	0.93	1.26	1.27	1.04	0.74	0.79	0.93	1.26	1.27	1.04	0.46	0.45	0.45	0.46	0.54	0.21
19	0.44	0.38	0.41	0.62	1.06	0.88	0.44	0.38	0.41	0.62	1.06	0.88	0.60	0.54	0.51	0.63	0.69	0.27
20	1.12	0.68	0.63	1.04	1.93	1.33	1.12	0.67	0.63	1.03	1.92	1.33	0.92	0.68	0.74	0.92	0.79	0.31
Mean	0.84	0.77	0.87	1.16	1.34	1.06	0.84	0.77	0.87	1.16	1.34	1.05	0.68	0.61	0.58	0.62	0.67	0.24

Note:
Storey height = 2750 mm

Table C.4.5 Inter-storey drift of 4-storey building in E-W direction (without GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.02	1.04	1.50	0.45	1.07	0.85	1.67	0.42	0.97	0.81	0.79	0.27
2	1.00	0.95	1.06	0.39	1.08	0.78	1.13	0.41	1.20	0.76	0.68	0.18
3	1.00	0.93	1.09	0.41	1.09	0.67	1.29	0.36	0.93	0.89	1.12	0.37
4	1.11	1.01	1.15	0.38	1.10	0.76	1.42	0.36	0.84	0.83	0.92	0.30
5	0.74	0.76	0.93	0.40	0.79	0.64	0.91	0.36	0.63	0.68	0.58	0.24
6	1.43	0.66	0.82	0.39	1.53	0.58	0.84	0.38	0.66	0.72	0.76	0.29
7	1.20	1.18	0.70	0.32	1.31	1.01	0.73	0.30	1.21	0.80	0.52	0.11
8	0.49	0.62	1.48	0.44	0.49	0.44	1.79	0.41	0.60	0.70	0.82	0.24
9	0.93	0.87	0.96	0.41	0.95	0.70	1.10	0.37	0.87	0.65	0.57	0.13
10	1.24	0.89	0.60	0.34	1.16	0.77	0.71	0.33	0.76	0.59	0.55	0.21
11	1.25	1.00	0.60	0.32	1.37	0.86	0.63	0.31	0.92	0.78	0.87	0.31
12	1.40	1.06	1.06	0.45	1.10	1.04	1.32	0.46	0.88	0.76	0.98	0.37
13	0.81	0.70	0.79	0.42	0.83	0.61	0.94	0.38	0.60	0.67	0.63	0.23
14	1.35	0.67	0.60	0.34	1.39	0.58	0.62	0.35	1.12	0.73	0.68	0.29
15	0.89	0.82	1.02	0.43	0.98	0.72	1.11	0.41	0.95	0.86	1.16	0.25
16	0.80	0.65	0.68	0.33	0.81	0.62	0.75	0.31	0.56	0.57	0.59	0.27
17	1.03	0.66	0.60	0.35	0.93	0.55	0.82	0.34	0.61	0.69	0.57	0.27
18	0.94	0.69	0.65	0.60	1.11	0.52	0.68	0.58	0.67	0.64	0.77	0.27
19	0.61	0.71	1.53	0.46	0.68	0.51	1.76	0.46	0.66	0.65	0.83	0.29
20	1.19	1.10	1.14	0.44	1.17	0.84	1.36	0.44	0.95	0.93	0.80	0.29
Mean	1.02	0.85	0.95	0.40	1.05	0.70	1.08	0.39	0.83	0.74	0.76	0.26

Note:
Storey height = 2750 mm

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Table C.4.6 Inter-storey drift of 4-storey building in N-S direction (without GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.10	1.09	1.49	1.05	1.10	1.09	1.49	1.05	0.97	0.81	0.79	0.27
2	0.82	0.94	1.25	0.86	0.82	0.94	1.25	0.86	1.20	0.76	0.68	0.18
3	1.06	0.92	1.12	0.69	1.05	0.92	1.11	0.69	0.93	0.89	1.12	0.37
4	1.24	1.02	1.20	0.88	1.24	1.02	1.20	0.88	0.84	0.83	0.92	0.30
5	1.42	1.19	1.26	0.93	1.42	1.19	1.26	0.92	0.63	0.68	0.58	0.24
6	1.12	0.99	1.17	0.86	1.12	0.99	1.17	0.86	0.66	0.72	0.76	0.29
7	1.06	1.14	1.33	0.82	1.06	1.14	1.33	0.82	1.21	0.80	0.52	0.11
8	0.66	0.89	1.31	0.89	0.66	0.89	1.31	0.89	0.60	0.70	0.82	0.24
9	1.20	1.04	1.20	0.85	1.20	1.04	1.20	0.85	0.87	0.65	0.57	0.13
10	1.12	1.08	1.27	0.99	1.12	1.08	1.27	0.99	0.76	0.59	0.55	0.21
11	1.28	1.20	1.33	0.93	1.28	1.19	1.33	0.93	0.92	0.78	0.87	0.31
12	1.12	1.07	1.15	0.85	1.12	1.07	1.15	0.85	0.88	0.76	0.98	0.37
13	0.85	0.66	0.81	0.57	0.85	0.66	0.81	0.57	0.60	0.67	0.63	0.23
14	1.28	0.94	0.94	0.68	1.28	0.94	0.94	0.68	1.12	0.73	0.68	0.29
15	1.03	0.85	0.99	0.68	1.03	0.85	1.00	0.68	0.95	0.86	1.16	0.25
16	1.25	1.02	1.27	1.00	1.25	1.02	1.27	1.00	0.56	0.57	0.59	0.27
17	0.83	0.62	0.72	0.50	0.82	0.62	0.72	0.50	0.61	0.69	0.57	0.27
18	1.10	0.87	1.04	0.86	1.10	0.87	1.04	0.86	0.67	0.64	0.77	0.27
19	0.52	0.62	1.08	1.68	0.52	0.62	1.08	1.68	0.66	0.65	0.83	0.29
20	1.05	1.09	1.38	0.94	1.05	1.09	1.38	0.94	0.95	0.93	0.80	0.29
Mean	1.05	0.96	1.17	0.88	1.05	0.96	1.17	0.88	0.83	0.74	0.76	0.26

Note:
Storey height = 2750 mm

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Table C.4.7 Inter-storey drift of 6-storey building in E-W direction (without GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.76	0.83	0.83	0.75	1.35	0.52	0.80	0.63	1.04	0.81	1.11	0.48	0.51	0.55	0.63	0.53	0.48	0.19
2	0.48	0.51	0.78	0.89	1.62	0.50	0.45	0.49	0.91	0.77	1.43	0.49	0.58	0.62	0.63	0.45	0.32	0.16
3	0.82	0.72	0.78	0.75	1.58	0.49	0.82	0.61	0.96	0.72	1.75	0.48	0.59	0.49	0.61	0.71	0.61	0.21
4	0.92	0.90	0.84	0.72	1.19	0.45	0.95	0.65	1.05	0.64	1.26	0.45	0.51	0.59	0.60	0.52	0.43	0.21
5	1.28	1.21	1.12	0.67	0.66	0.38	1.05	0.79	1.47	0.76	0.93	0.43	0.45	0.43	0.42	0.35	0.32	0.17
6	1.08	1.05	0.92	0.62	0.74	0.40	0.96	0.69	1.13	0.67	1.05	0.42	0.42	0.43	0.43	0.38	0.39	0.20
7	0.58	0.65	0.91	0.97	0.92	0.41	0.58	0.59	1.17	0.83	0.67	0.38	0.64	0.62	0.73	0.47	0.36	0.17
8	1.16	0.82	0.72	0.64	1.04	0.41	1.23	0.64	0.81	0.57	0.91	0.40	0.37	0.44	0.52	0.54	0.37	0.19
9	1.27	1.08	1.05	0.71	0.74	0.42	1.19	0.88	1.43	0.74	0.90	0.47	0.53	0.48	0.47	0.33	0.25	0.13
10	1.03	0.90	0.85	0.64	0.81	0.40	0.88	0.66	1.22	0.77	1.03	0.42	0.45	0.37	0.36	0.27	0.20	0.12
11	0.58	0.71	1.01	0.98	1.37	0.54	0.51	0.61	1.12	0.81	1.39	0.48	0.59	0.61	0.53	0.45	0.32	0.14
12	0.58	0.57	0.78	0.80	0.86	0.48	0.57	0.54	0.90	0.81	1.02	0.49	0.63	0.56	0.55	0.49	0.45	0.23
13	1.35	1.19	1.11	0.77	0.75	0.42	1.16	0.83	1.39	0.72	0.97	0.47	0.42	0.40	0.43	0.38	0.38	0.16
14	1.21	0.94	0.99	0.76	0.76	0.43	1.20	0.76	1.31	0.71	0.75	0.43	0.73	0.56	0.57	0.36	0.32	0.19
15	1.44	1.32	1.26	0.78	0.76	0.43	1.34	0.90	1.63	0.74	0.74	0.41	0.52	0.60	0.60	0.50	0.59	0.22
16	1.29	1.10	0.77	0.61	0.73	0.41	1.29	0.76	1.03	0.65	0.80	0.40	0.38	0.38	0.37	0.32	0.29	0.15
17	1.00	0.83	1.07	0.78	0.79	0.43	0.85	0.65	1.35	0.67	0.89	0.44	0.38	0.40	0.38	0.33	0.27	0.13
18	0.75	0.75	0.98	0.78	0.82	0.43	0.79	0.65	1.22	0.65	0.75	0.39	0.37	0.39	0.39	0.38	0.31	0.17
19	0.54	0.42	0.54	0.52	2.04	0.45	0.54	0.42	0.49	0.47	2.01	0.48	0.36	0.44	0.49	0.49	0.38	0.19
20	1.15	0.82	0.72	0.89	1.91	0.51	1.14	0.70	1.00	0.73	1.93	0.42	0.55	0.60	0.67	0.50	0.46	0.20
Mean	0.96	0.87	0.90	0.75	1.07	0.45	0.91	0.67	1.13	0.71	1.11	0.44	0.50	0.50	0.52	0.44	0.37	0.18

Note:
Storey height = 2750 mm

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Table C.4.8 Inter-storey drift of 6-storey building in N-S direction (without GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.80	0.83	0.84	0.90	1.21	0.88	0.80	0.83	0.84	0.90	1.21	0.87	0.51	0.55	0.63	0.53	0.48	0.19
2	0.60	0.55	0.59	0.94	1.47	1.02	0.60	0.55	0.59	0.94	1.47	1.02	0.58	0.62	0.63	0.45	0.32	0.16
3	1.03	0.77	0.73	1.24	1.66	1.17	1.02	0.77	0.73	1.23	1.66	1.17	0.59	0.49	0.61	0.71	0.61	0.21
4	0.85	0.82	0.85	1.03	1.36	1.01	0.85	0.82	0.85	1.03	1.36	1.01	0.51	0.59	0.60	0.52	0.43	0.21
5	0.69	0.75	0.85	1.12	1.26	0.95	0.68	0.75	0.85	1.13	1.26	0.96	0.45	0.43	0.42	0.35	0.32	0.17
6	0.78	0.84	0.93	1.47	1.70	1.39	0.78	0.84	0.93	1.47	1.70	1.39	0.42	0.43	0.43	0.38	0.39	0.20
7	0.89	0.68	0.75	1.05	1.35	0.94	0.89	0.68	0.75	1.05	1.35	0.94	0.64	0.62	0.73	0.47	0.36	0.17
8	1.05	0.88	1.02	1.54	1.63	1.12	1.05	0.88	1.02	1.53	1.62	1.12	0.37	0.44	0.52	0.54	0.37	0.19
9	1.08	0.93	1.06	1.36	1.23	0.93	1.08	0.93	1.06	1.36	1.23	0.92	0.53	0.48	0.47	0.33	0.25	0.13
10	0.77	0.77	0.89	1.50	1.78	1.36	0.77	0.77	0.89	1.49	1.77	1.35	0.45	0.37	0.36	0.27	0.20	0.12
11	0.95	0.74	0.83	1.30	1.37	0.94	0.95	0.74	0.82	1.29	1.37	0.93	0.59	0.61	0.53	0.45	0.32	0.14
12	0.57	0.59	0.53	0.65	0.95	0.81	0.57	0.58	0.53	0.65	0.95	0.81	0.63	0.56	0.55	0.49	0.45	0.23
13	1.14	1.10	1.24	1.59	1.54	1.23	1.14	1.10	1.24	1.59	1.54	1.23	0.42	0.40	0.43	0.38	0.38	0.16
14	1.00	0.93	0.97	1.35	1.51	0.94	1.00	0.93	0.97	1.34	1.50	0.94	0.73	0.56	0.57	0.36	0.32	0.19
15	0.69	0.63	0.72	1.24	1.58	1.24	0.69	0.63	0.72	1.23	1.58	1.24	0.52	0.60	0.60	0.50	0.59	0.22
16	0.81	0.91	1.05	1.43	1.42	1.06	0.80	0.90	1.04	1.42	1.41	1.06	0.38	0.38	0.37	0.32	0.29	0.15
17	0.81	0.82	0.88	1.53	1.90	1.58	0.80	0.81	0.88	1.52	1.90	1.57	0.38	0.40	0.38	0.33	0.27	0.13
18	0.95	0.78	0.76	1.02	1.17	0.84	0.95	0.77	0.76	1.01	1.17	0.84	0.37	0.39	0.39	0.38	0.31	0.17
19	0.58	0.43	0.40	0.66	1.77	1.49	0.58	0.43	0.40	0.66	1.77	1.49	0.36	0.44	0.49	0.49	0.38	0.19
20	1.33	0.84	0.57	0.93	1.99	1.63	1.33	0.84	0.57	0.93	1.98	1.63	0.55	0.60	0.67	0.50	0.46	0.20
Mean	0.87	0.78	0.82	1.19	1.49	1.13	0.87	0.78	0.82	1.19	1.49	1.12	0.50	0.50	0.52	0.44	0.37	0.18

Note:
Storey height = 2750 mm

C.5 Maximum shear wall deformation at each storey

Table C.5.1 Shear wall deformation of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D							
	Wall 8				Wall 4			
	st1	st2	st3	st4	st1	st2	st3	st4
1	32.9	23.3	16.2	6.0	34.1	19.0	16.3	5.9
2	33.9	22.5	14.7	6.0	38.3	18.5	14.1	4.9
3	31.5	23.4	11.7	5.1	33.6	19.3	11.4	5.4
4	17.1	17.4	16.1	6.8	15.3	13.5	16.8	6.0
5	23.5	13.1	10.9	5.7	24.8	11.6	10.0	5.1
6	15.0	12.0	9.4	3.9	14.0	10.1	9.2	3.7
7	40.0	28.5	12.4	5.1	40.8	24.3	11.3	3.9
8	23.2	25.7	18.6	6.8	27.3	20.8	16.9	6.0
9	17.8	13.4	10.4	4.9	20.4	10.9	9.6	4.0
10	21.2	13.8	12.2	6.1	22.5	11.9	10.9	4.8
11	36.2	20.4	15.5	6.9	37.5	17.8	13.8	4.8
12	42.8	24.4	15.0	6.5	45.4	22.1	15.3	6.2
13	15.0	12.5	10.6	4.7	15.8	10.5	10.4	3.7
14	23.5	11.3	11.6	6.7	24.6	10.0	11.0	5.5
15	31.5	21.3	13.4	5.8	30.7	15.3	13.1	5.0
16	18.3	13.4	10.5	4.8	19.0	11.4	10.4	3.8
17	25.8	13.5	9.4	4.6	26.1	11.2	9.0	4.3
18	18.8	14.9	12.9	6.5	20.2	12.8	13.0	5.3
19	28.5	22.4	16.1	6.3	30.6	17.2	14.9	5.2
20	26.8	27.4	21.8	7.8	28.3	22.4	20.4	6.3
Mean	26.2	18.7	13.5	5.8	27.5	15.5	12.9	5.0

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Table C.5.2 Shear wall deformation of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D							
	Wall 19				Wall 25			
	st1	st2	st3	st4	st1	st2	st3	st4
1	21.5	17.6	20.0	8.1	22.0	20.7	22.8	11.3
2	18.0	16.1	13.3	5.6	18.7	17.4	14.8	7.5
3	17.4	14.9	14.5	5.4	18.1	16.2	16.0	7.0
4	23.6	14.4	17.3	8.8	24.1	16.5	19.2	11.4
5	20.9	15.3	14.7	6.9	21.6	16.4	16.2	8.2
6	24.8	16.2	14.7	7.1	25.4	17.3	16.2	8.4
7	22.2	18.2	13.6	4.4	22.8	20.9	16.6	6.7
8	10.5	9.0	13.7	5.3	11.1	10.3	15.7	6.8
9	22.2	17.3	14.7	5.0	22.9	18.9	16.5	6.6
10	23.8	14.6	11.9	5.4	24.5	16.2	13.9	6.4
11	25.2	15.5	11.6	3.7	26.1	19.0	15.1	6.0
12	32.7	22.3	16.4	7.6	33.4	24.2	18.6	9.6
13	21.0	10.5	9.2	4.4	21.5	11.4	10.3	5.0
14	25.4	12.5	10.4	7.0	25.9	13.4	11.5	7.9
15	19.3	14.2	13.3	5.4	20.1	15.6	14.9	6.9
16	20.4	11.9	11.0	4.4	21.0	13.0	12.3	5.7
17	16.6	8.7	8.0	3.2	17.1	9.6	9.0	3.7
18	21.6	13.0	10.2	6.5	22.2	14.0	11.7	7.7
19	14.1	11.8	15.8	7.8	14.2	12.9	17.7	9.0
20	23.0	14.3	14.4	7.6	23.8	17.2	17.5	8.5
Mean	21.2	14.4	13.4	6.0	21.8	16.1	15.3	7.5

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Table C.5.3 Shear wall deformation of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D											
	Wall 8						Wall 4					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	19.5	19.0	23.1	20.8	17.6	7.0	17.0	14.6	29.9	18.2	15.0	5.0
2	15.6	14.9	18.7	17.1	14.3	6.8	16.0	13.3	19.7	13.3	12.1	5.5
3	17.0	16.2	16.8	14.4	15.0	7.4	16.1	14.3	21.6	12.0	12.0	5.2
4	19.5	19.1	23.2	20.9	17.6	6.8	18.9	15.9	29.1	18.4	15.7	5.5
5	20.3	18.8	17.4	14.1	10.7	5.0	20.6	14.4	19.5	11.4	9.3	4.0
6	22.5	20.1	17.2	14.8	12.6	5.9	20.6	14.5	17.5	11.7	11.7	4.6
7	16.5	17.7	22.6	19.2	15.3	6.7	15.7	15.0	24.7	13.4	10.7	4.4
8	11.7	12.7	17.1	19.5	19.1	8.1	11.7	11.8	17.0	15.0	16.1	5.7
9	19.7	20.1	22.0	17.3	12.2	5.2	19.0	16.4	28.1	15.6	12.4	4.8
10	17.3	16.5	16.9	14.3	10.8	5.2	18.6	13.9	17.6	10.9	8.9	3.6
11	20.8	21.8	23.4	19.0	13.7	6.4	22.5	18.3	25.5	14.0	11.8	4.7
12	19.9	20.7	20.6	15.5	14.6	7.3	20.0	17.2	24.9	13.3	11.0	4.6
13	15.4	13.8	14.7	12.2	9.2	4.6	13.3	11.9	14.2	9.7	8.5	3.6
14	23.5	16.4	15.8	11.7	10.0	5.9	22.4	14.7	16.7	10.2	9.9	4.6
15	18.3	17.1	17.5	16.0	14.1	6.8	15.1	13.3	18.9	12.1	11.4	4.6
16	15.6	15.6	18.5	16.0	12.3	6.0	14.9	13.2	22.3	13.5	11.4	4.4
17	16.0	13.8	13.3	11.2	9.2	4.5	14.8	11.9	11.9	8.9	7.8	3.3
18	17.1	15.3	16.1	15.5	13.7	6.9	17.1	13.9	18.5	11.0	11.6	5.1
19	10.8	11.6	11.5	13.8	17.2	8.0	10.9	11.4	12.1	11.6	16.0	6.5
20	14.8	17.0	22.5	20.6	16.5	7.6	14.7	14.8	25.1	16.8	14.0	5.4
Mean	17.6	16.9	18.5	16.2	13.8	6.4	17.0	14.2	20.7	13.0	11.9	4.7

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Table C.5.4 Shear wall deformation of 6-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D											
	Wall 19						Wall 25					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	17.9	12.7	8.9	9.8	11.6	3.9	18.7	13.9	10.2	11.1	12.9	5.3
2	13.3	9.7	7.8	9.6	19.5	8.3	13.7	10.0	8.4	11.0	21.3	10.4
3	22.5	12.7	9.8	14.8	19.1	7.5	23.0	13.4	10.6	17.3	21.6	9.8
4	15.6	11.9	8.6	9.6	15.8	6.4	16.1	12.7	9.4	10.9	17.3	7.8
5	14.8	13.3	11.1	12.2	11.4	3.7	15.3	14.1	12.2	16.0	14.9	5.1
6	17.0	13.6	11.1	13.0	9.6	3.0	18.6	15.4	13.3	15.2	11.5	4.4
7	16.4	10.6	9.3	10.6	11.7	4.0	16.9	11.2	10.1	11.7	13.3	5.2
8	28.5	14.3	11.2	14.2	17.9	6.3	29.0	15.1	12.6	16.3	20.2	8.3
9	21.7	14.1	12.4	13.8	10.3	3.3	24.0	16.3	15.3	17.0	13.4	5.9
10	14.8	12.1	10.4	15.1	18.5	7.6	15.2	12.7	11.5	18.6	21.3	10.3
11	15.6	10.2	10.0	13.5	12.8	5.7	16.1	11.1	11.3	15.1	14.5	7.3
12	13.9	10.4	9.2	9.5	9.7	7.1	14.0	10.6	9.7	10.2	10.5	7.9
13	21.2	14.0	11.0	11.5	9.8	3.2	21.8	15.8	13.7	14.1	11.4	4.5
14	23.4	14.7	12.3	16.4	13.6	5.8	23.9	15.6	13.7	18.2	15.5	7.3
15	15.4	13.1	11.9	17.8	15.3	6.9	16.7	14.1	13.9	20.6	18.3	9.7
16	18.4	13.3	10.5	11.0	10.8	4.1	19.2	14.1	11.8	13.9	13.1	5.8
17	22.3	12.3	12.0	18.6	15.5	6.5	22.8	13.0	13.5	21.8	19.0	9.6
18	15.8	12.4	9.4	12.7	9.4	3.7	16.3	13.2	11.0	15.2	11.8	5.5
19	11.8	9.6	6.0	6.8	12.9	7.0	11.9	9.8	6.1	7.4	14.3	7.9
20	27.7	13.9	8.5	11.6	31.0	13.4	28.2	14.5	9.2	14.1	34.7	17.4
Mean	18.4	12.4	10.1	12.6	14.3	5.9	19.1	13.3	11.4	14.8	16.5	7.8

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Table C.5.5 Shear wall deformation of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D							
	Wall 8				Wall 4			
	st1	st2	st3	st4	st1	st2	st3	st4
1	27.6	27.5	39.7	10.3	28.8	22.1	44.8	9.8
2	26.8	25.3	28.0	9.1	28.9	20.1	29.8	9.4
3	26.7	24.4	28.2	9.2	29.2	17.4	34.2	8.3
4	29.9	26.7	30.1	8.7	29.8	19.9	37.7	8.4
5	19.7	19.8	23.8	9.0	21.1	16.4	23.7	8.3
6	38.9	17.0	21.6	9.2	41.5	15.1	22.1	9.1
7	32.2	31.3	18.0	7.3	35.5	26.6	18.5	6.6
8	12.9	16.1	39.5	10.3	12.7	11.1	48.0	9.8
9	24.9	22.7	24.9	9.5	25.8	18.3	28.9	8.5
10	33.4	23.5	15.1	7.7	31.2	20.0	18.3	7.4
11	33.8	26.4	15.3	7.2	36.8	22.5	16.0	7.0
12	37.8	28.0	28.1	10.9	29.6	27.6	35.0	10.8
13	21.7	18.0	20.4	10.0	22.3	15.7	24.4	8.5
14	36.3	17.9	15.2	8.3	37.5	15.3	15.8	8.2
15	23.8	21.4	26.6	10.2	26.4	18.8	29.2	9.2
16	21.3	16.6	17.1	7.7	21.8	16.1	19.2	6.7
17	27.7	17.2	15.2	8.2	24.9	14.0	21.1	7.5
18	25.4	18.2	16.8	15.2	30.0	13.2	17.3	14.5
19	16.7	18.5	41.0	11.7	18.5	13.0	47.3	10.9
20	32.0	29.3	30.1	10.5	31.2	21.8	36.1	10.7
Mean	27.5	22.3	24.7	9.5	28.2	18.2	28.4	9.0

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Table C.5.6 Shear wall deformation of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D							
	Wall 19				Wall 25			
	st1	st2	st3	st4	st1	st2	st3	st4
1	25.8	21.0	28.7	15.6	26.5	22.5	30.7	17.9
2	17.8	15.3	20.7	12.5	18.6	17.0	23.2	14.1
3	26.3	17.8	20.8	8.7	26.8	18.9	22.0	9.7
4	29.7	20.2	23.1	14.1	30.3	21.2	24.8	15.8
5	35.2	24.5	23.8	15.1	35.7	25.7	25.6	17.0
6	26.2	16.7	21.0	12.0	26.8	19.1	22.9	13.7
7	25.3	20.7	22.4	8.2	25.9	22.5	24.6	10.3
8	15.2	14.0	21.6	8.5	15.7	15.7	24.4	11.4
9	29.2	19.9	19.1	7.8	29.7	21.0	21.0	10.0
10	27.0	19.8	19.3	9.7	27.6	21.2	22.5	13.4
11	31.1	23.3	20.6	7.9	31.7	24.4	23.6	11.1
12	26.7	21.4	21.7	9.9	27.2	22.5	23.0	11.8
13	20.5	11.4	13.4	6.6	20.9	12.3	14.6	7.3
14	31.4	17.2	17.4	9.1	31.9	18.5	18.5	10.2
15	24.5	15.0	17.5	7.6	25.1	16.1	18.7	8.9
16	30.5	20.2	19.5	10.3	31.1	21.3	22.8	14.3
17	19.8	10.1	9.8	5.2	20.2	10.9	10.9	5.9
18	26.1	15.1	15.2	9.5	26.7	16.0	17.5	11.4
19	14.1	9.1	20.0	36.9	14.1	9.9	21.4	38.5
20	23.6	18.1	26.8	16.2	24.4	20.8	28.5	17.9
Mean	25.2	17.5	20.1	11.6	25.8	18.9	22.1	13.5

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Table C.5.7 Shear wall deformation of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D											
	Wall 8						Wall 4					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	20.1	21.3	20.7	17.8	33.7	10.2	21.0	15.2	26.3	19.1	27.7	9.3
2	12.5	12.6	19.2	22.0	42.1	10.9	11.9	11.6	22.4	18.0	37.4	10.3
3	21.8	18.3	18.7	17.6	40.4	10.1	21.9	15.3	24.4	16.5	44.9	9.0
4	24.2	23.0	20.8	16.6	29.1	8.3	24.9	15.6	26.0	14.6	31.5	8.3
5	34.2	31.5	28.6	15.7	15.0	7.8	27.6	19.2	37.3	17.7	21.4	7.5
6	28.7	27.2	23.2	14.3	16.9	7.5	25.2	16.8	28.6	15.4	25.3	7.5
7	15.0	16.0	22.6	23.9	23.0	9.1	14.8	14.2	29.9	19.3	15.2	6.9
8	31.2	20.7	17.3	15.0	26.3	8.3	32.7	15.6	20.2	13.3	22.5	7.6
9	34.1	28.3	26.0	16.4	17.1	7.6	31.5	22.1	36.3	17.6	21.9	8.5
10	27.2	23.1	21.3	14.7	19.6	7.7	23.0	16.0	30.3	17.2	24.4	7.8
11	15.0	17.9	25.2	24.4	35.0	11.1	12.9	14.8	27.7	18.7	35.0	8.6
12	15.0	14.1	18.9	19.1	21.0	10.3	14.8	13.4	22.3	19.4	24.9	10.4
13	36.1	30.9	28.1	18.3	17.4	8.2	30.6	20.4	35.4	16.0	22.4	8.1
14	32.2	24.4	24.7	18.1	18.6	9.0	31.7	19.4	33.7	17.0	17.9	7.7
15	38.6	34.3	32.1	18.5	17.3	8.7	35.5	22.6	42.3	17.4	16.4	7.6
16	34.6	28.5	18.8	13.9	17.8	7.9	34.8	18.9	25.6	15.1	19.5	7.7
17	26.4	21.1	27.1	18.7	18.0	8.1	22.2	15.8	34.3	14.7	21.3	8.0
18	19.5	18.9	24.5	18.6	19.3	8.7	20.9	15.8	30.6	14.4	16.5	7.2
19	14.6	10.8	13.1	12.2	55.1	11.5	14.4	11.2	11.7	10.8	54.0	11.5
20	30.7	21.1	17.9	22.2	50.6	10.7	30.6	17.8	25.8	16.9	50.7	9.4
Mean	25.6	22.2	22.4	17.9	26.7	9.1	24.1	16.6	28.6	16.5	27.5	8.4

Table C.5.8 Shear wall deformation of 6-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D											
	Wall 19						Wall 25					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	16.8	13.3	10.3	12.0	19.1	8.3	17.4	14.3	11.5	13.2	20.4	9.7
2	13.7	10.0	7.4	11.1	27.0	13.7	14.1	10.6	7.9	12.7	28.6	15.4
3	25.4	15.7	10.2	18.9	27.8	13.6	25.7	16.4	11.2	20.9	30.1	16.1
4	19.4	13.3	10.1	11.4	20.6	9.0	19.7	14.2	11.2	12.9	22.1	10.9
5	15.1	12.4	10.2	13.2	14.0	6.3	15.4	13.1	11.4	15.1	16.3	7.6
6	17.2	13.4	11.8	17.9	18.1	9.7	17.7	14.3	13.2	20.3	21.4	12.5
7	20.3	11.5	10.2	15.4	19.5	7.1	20.8	12.4	11.1	16.7	21.1	8.4
8	25.1	14.5	14.4	25.1	26.9	14.0	25.5	15.8	16.3	27.5	30.1	17.2
9	23.8	15.4	14.9	19.5	14.4	6.5	24.7	16.9	16.9	21.7	16.5	8.4
10	17.7	13.9	11.7	21.7	26.5	13.1	18.1	14.7	12.9	25.1	29.8	16.8
11	21.8	12.8	10.5	19.5	19.0	6.5	22.3	13.6	11.6	21.0	20.6	7.8
12	14.7	13.1	9.2	9.9	14.1	11.8	14.9	13.4	9.6	10.6	15.2	13.1
13	22.7	16.5	13.8	18.4	17.3	7.3	24.1	17.8	16.6	21.7	19.5	9.0
14	23.5	16.9	15.2	22.2	23.1	9.1	24.0	17.9	16.8	24.1	25.1	10.7
15	14.7	11.0	9.4	18.5	24.5	13.6	15.2	11.5	10.3	20.5	27.1	16.5
16	16.7	14.2	13.8	20.2	16.7	7.6	17.3	15.7	15.8	22.5	19.0	9.3
17	17.5	14.0	11.4	22.6	29.0	18.5	18.0	14.7	12.7	26.2	33.4	23.4
18	21.9	13.9	10.6	12.1	14.9	6.8	22.4	14.6	11.4	13.8	16.8	7.6
19	14.4	10.5	8.4	8.6	33.7	30.3	14.7	10.7	8.7	9.6	35.9	32.4
20	34.2	18.4	10.1	12.3	40.0	31.9	34.7	19.2	10.7	13.9	42.6	34.6
Mean	19.8	13.7	11.2	16.5	22.3	12.2	20.3	14.6	12.4	18.5	24.6	14.4

C.6 Maximum uplift forces and deformations

Table C.6.1 Maximum uplift forces of 4-storey building in E-W direction (with GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4- method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	39.0	20.8	8.2	0.0	59.8	30.8	9.4	0	50.4	26.5	20.1	6.8	19.8	21.9	14.8	6.3
2	49.3	22.3	8.0	0.2	63.2	32.9	11.3	0.3	59.3	28.7	19.6	7.3	39.0	32.3	17.1	5.9
3	29.4	11.6	7.3	1.1	36.3	14.0	8.3	1.1	63.5	34.6	26.4	11.4	33.3	37.8	23.7	9.5
4	30.6	22.4	12.1	2.2	36.8	27.3	13.5	3.0	64.1	35.9	29.1	13.3	35.2	37.4	24.3	11.0
5	32.3	15.8	7.1	0.3	32.9	16.6	8.7	0.4	45.1	26.3	18.3	10.9	22.8	23.7	13.8	6.1
6	27.9	12.4	0.0	0.0	36.7	17.0	0	0	53.2	27.5	21.1	9.8	25.3	23.6	16.3	7.1
7	42.9	20.9	4.7	0.0	66.4	32.2	6.4	0	26.1	17.7	16.2	7.9	21.4	18.6	6.6	4.0
8	50.7	26.5	10.5	1.9	62.7	39.2	14.6	2.4	55.1	28.4	23.5	17.6	30.7	34.7	20.8	9.2
9	37.3	16.5	3.3	0.0	43.5	22.2	4.0	0	45.9	20.5	16.0	6.7	22.5	25.8	14.0	5.8
10	36.2	18.5	7.3	0.0	37.0	23.2	9.6	0	54.1	25.5	18.5	10.0	21.8	25.7	13.9	6.5
11	51.3	28.1	8.1	0.1	62.2	32.7	11.4	0.1	75.7	37.8	26.9	9.6	33.1	30.4	22.4	12.6
12	46.0	25.0	10.8	1.6	58.1	31.9	12.2	1.9	80.6	46.8	36.7	19.2	32.9	34.8	22.2	12.5
13	32.1	17.2	4.7	0.0	45.2	24.0	5.9	0	45.4	24.2	15.3	8.1	22.8	22.1	11.3	5.4
14	23.2	8.7	9.2	1.1	25.5	8.5	10.7	1.5	58.3	26.5	18.9	12.0	37.8	28.3	17.4	8.0
15	36.5	18.6	7.1	0.0	49.4	25.8	7.9	0	61.5	35.3	23.1	11.3	32.7	33.1	20.9	10.9
16	15.1	36.6	18.3	33.9	20.2	44.0	20.2	44.0	44.6	23.6	20.1	10.0	23.2	21.1	13.7	5.7
17	33.1	15.1	2.8	0.0	48.3	21.1	3.2	0	43.3	25.1	23.5	12.5	30.1	24.2	13.5	6.6
18	36.5	21.1	8.0	0.8	52.6	31.2	11.4	1.1	40.2	23.6	24.6	12.2	26.8	22.7	19.7	10.1
19	40.8	21.8	8.3	0.9	61.7	33.0	12.0	1.3	52.8	37.3	28.4	14.4	32.2	37.0	25.1	12.4
20	46.0	27.8	12.1	2.6	70.6	42.1	17.9	3.8	55.6	26.9	19.7	10.4	35.3	33.9	21.5	10.2
Mean	36.8	20.4	7.9	2.3	48.4	27.5	10.4	5.1	53.7	28.9	22.3	11.1	28.9	28.4	17.7	8.3

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Table C.6.2 Maximum uplift forces of 4-storey building in N-S direction (with GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	110.8	58.8	29.5	6.9	97.5	58.7	30.7	11.1	9.0	5.7	6.3	4.0	34.9	37.6	26.5	14.1
2	106.2	58.7	34.4	13.4	90.9	58.7	33.5	16.2	15.8	8.3	7.6	5.9	40.3	36.0	24.2	9.8
3	84.9	58.7	38.7	14.2	74.3	57.6	35.0	15.1	16.2	7.5	7.5	4.8	39.4	39.2	29.1	15.6
4	87.2	58.7	36.9	13.8	75.2	53.7	32.7	14.0	12.2	6.8	8.6	6.3	38.5	37.9	27.5	13.6
5	102.2	58.7	34.9	10.6	88.7	58.7	32.7	11.7	13.0	7.1	8.0	5.0	32.7	33.7	23.2	10.7
6	110.4	58.8	30.6	6.6	98.4	58.7	32.4	11.6	15.0	7.1	6.4	5.0	31.7	33.2	24.6	15.0
7	114.5	58.8	32.8	10.4	101.2	58.7	34.1	14.2	8.6	6.7	5.9	3.3	21.3	14.9	11.6	4.9
8	96.3	58.7	40.3	13.0	84.5	58.7	37.0	14.8	16.0	9.7	11.7	8.2	33.6	36.4	25.8	13.0
9	104.3	58.7	27.7	4.5	89.8	56.5	28.4	8.7	15.7	7.4	5.9	3.2	35.9	31.7	21.1	7.7
10	108.7	58.7	34.2	9.8	93.5	58.7	34.1	13.7	13.9	9.0	8.4	4.8	32.7	33.5	23.6	10.4
11	115.1	58.8	31.5	6.4	103.0	58.8	33.5	12.7	22.2	10.4	8.0	5.1	39.5	37.2	27.7	14.3
12	102.4	58.7	41.6	15.2	89.4	58.7	39.5	17.7	18.4	12.4	13.8	7.4	38.9	36.4	28.3	17.6
13	79.1	44.6	23.9	6.6	69.0	41.3	23.1	7.3	14.8	6.9	5.1	4.1	33.3	34.1	24.0	12.9
14	72.1	41.8	24.4	18.6	62.5	38.2	23.1	16.9	14.6	8.0	8.0	5.8	40.9	36.8	23.5	14.7
15	106.5	58.7	32.7	6.7	94.4	58.7	31.9	10.6	19.2	11.1	13.4	6.3	42.1	38.6	28.8	13.3
16	79.7	41.1	21.7	8.2	69.1	38.1	21.0	8.6	15.3	7.7	7.1	4.3	31.0	32.5	23.4	12.4
17	91.2	53.1	22.3	5.6	79.8	49.3	22.2	6.5	20.8	11.5	10.4	5.5	32.8	36.2	24.0	13.2
18	86.6	58.7	36.6	17.2	75.7	53.6	32.7	16.7	14.2	9.4	10.8	5.5	33.5	33.6	25.6	13.6
19	89.2	58.7	46.8	19.3	78.2	58.7	42.4	20.0	15.5	8.3	8.5	5.8	31.6	34.3	26.7	15.0
20	114.9	58.8	36.6	13.9	99.0	58.7	36.9	17.9	17.3	10.0	9.2	7.2	38.6	37.3	26.5	14.4
Mean	98.1	56.0	32.9	11.0	85.7	54.7	31.8	13.3	15.4	8.5	8.5	5.4	35.2	34.5	24.8	12.8

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Table C.6.3 Maximum uplift deformation of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4- method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.40	1.26	0.50	0.00	2.10	2.07	0.62	0	1.78	1.84	1.39	0.47	0.70	1.52	1.03	0.44
2	1.78	1.35	0.49	0.01	2.22	2.22	0.76	0.01	2.10	1.99	1.36	0.51	1.38	2.24	1.19	0.41
3	1.03	0.70	0.48	0.09	1.27	0.92	0.59	0.10	2.24	2.40	1.83	0.79	1.18	2.62	1.64	0.66
4	1.16	1.38	0.78	0.13	1.29	1.81	0.92	0.20	2.27	2.49	2.02	0.92	1.24	2.59	1.68	0.76
5	1.14	1.04	0.48	0.02	1.15	1.08	0.61	0.03	1.60	1.82	1.27	0.76	0.81	1.65	0.96	0.42
6	1.06	0.76	0.00	0.00	1.28	1.12	0	0	1.88	1.91	1.46	0.68	0.89	1.64	1.13	0.49
7	1.53	1.29	0.30	0.00	2.35	2.22	0.44	0	0.92	1.22	1.12	0.55	0.76	1.29	0.46	0.27
8	1.79	1.55	0.64	0.11	2.20	2.63	0.97	0.14	1.95	1.97	1.63	1.22	1.09	2.40	1.44	0.64
9	1.30	1.07	0.21	0.00	1.52	1.48	0.27	0	1.62	1.42	1.11	0.46	0.80	1.79	0.97	0.40
10	1.24	1.12	0.47	0.00	1.28	1.51	0.65	0	1.91	1.76	1.28	0.69	0.77	1.78	0.97	0.45
11	1.71	1.77	0.50	0.00	2.19	2.21	0.77	0	2.68	2.62	1.86	0.66	1.17	2.11	1.55	0.87
12	1.61	1.49	0.69	0.10	2.03	2.13	0.83	0.13	2.85	3.24	2.55	1.33	1.16	2.41	1.54	0.87
13	1.12	1.04	0.29	0.00	1.59	1.62	0.38	0	1.60	1.68	1.06	0.56	0.81	1.53	0.79	0.37
14	0.06	0.52	0.63	0.08	0.07	0.51	0.74	0.11	2.06	1.84	1.31	0.83	1.34	1.96	1.21	0.55
15	1.27	1.14	0.47	0.00	1.73	1.70	0.56	0	2.17	2.44	1.60	0.78	1.16	2.30	1.45	0.76
16	1.00	0.98	0.16	0.00	1.32	1.22	0.19	0	1.58	1.64	1.40	0.69	0.82	1.46	0.95	0.40
17	1.17	0.95	0.17	0.00	1.69	1.40	0.21	0	1.53	1.74	1.63	0.86	1.06	1.67	0.94	0.46
18	1.28	1.28	0.50	0.05	1.84	2.09	0.76	0.07	1.42	1.64	1.71	0.84	0.95	1.57	1.37	0.70
19	1.50	1.47	0.51	0.05	2.15	2.21	0.80	0.07	1.87	2.58	1.97	0.99	1.14	2.56	1.74	0.86
20	1.63	1.64	0.74	0.15	2.48	2.84	1.21	0.25	1.97	1.86	1.36	0.72	1.25	2.35	1.49	0.71
Mean	1.29	1.19	0.45	0.04	1.69	1.75	0.65	0.11	1.90	2.01	1.55	0.77	1.02	1.97	1.22	0.57

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Table C.6.4 Maximum uplift deformation of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	3.93	8.27	2.05	0.48	3.46	5.53	2.13	0.77	0.32	0.39	0.44	0.28	1.23	2.61	1.84	0.98
2	3.77	6.91	2.39	0.93	3.22	4.67	2.33	1.13	0.56	0.57	0.53	0.41	1.42	2.50	1.68	0.68
3	3.01	4.94	2.69	0.98	2.64	4.00	2.44	1.05	0.57	0.52	0.52	0.33	1.39	2.72	2.02	1.08
4	3.09	4.58	2.57	0.96	2.67	3.73	2.27	0.97	0.43	0.47	0.59	0.44	1.36	2.63	1.90	0.94
5	3.62	5.88	2.43	0.74	3.15	4.31	2.27	0.81	0.46	0.49	0.55	0.35	1.15	2.33	1.61	0.74
6	3.91	8.88	2.12	0.46	3.49	5.81	2.25	0.81	0.53	0.49	0.44	0.34	1.12	2.30	1.70	1.04
7	4.06	10.29	2.28	0.72	3.59	7.32	2.37	0.99	0.31	0.47	0.41	0.23	0.75	1.03	0.81	0.34
8	3.42	6.55	2.80	0.91	3.00	5.13	2.57	1.03	0.57	0.67	0.81	0.57	1.19	2.52	1.79	0.90
9	3.70	5.51	1.93	0.31	3.18	3.92	1.97	0.60	0.56	0.51	0.41	0.22	1.27	2.20	1.46	0.54
10	3.85	7.23	2.37	0.68	3.32	4.53	2.37	0.95	0.49	0.62	0.58	0.33	1.16	2.32	1.64	0.72
11	4.39	10.78	2.19	0.44	3.65	7.54	2.33	0.88	0.79	0.72	0.55	0.36	1.40	2.58	1.92	0.99
12	3.63	7.46	2.89	1.06	3.17	5.36	2.75	1.23	0.65	0.86	0.96	0.51	1.38	2.53	1.96	1.22
13	2.81	3.10	1.66	0.46	2.45	2.87	1.60	0.50	0.52	0.48	0.36	0.28	1.18	2.36	1.66	0.90
14	2.56	2.90	1.69	1.29	2.22	2.65	1.61	1.17	0.51	0.55	0.56	0.40	1.45	2.55	1.63	1.02
15	3.77	7.33	2.27	0.47	3.35	5.12	2.22	0.74	0.68	0.77	0.93	0.44	1.49	2.68	1.99	0.92
16	2.82	2.86	1.51	0.57	2.45	2.65	1.46	0.60	0.54	0.54	0.49	0.30	1.10	2.25	1.62	0.86
17	3.23	3.69	1.55	0.39	2.83	3.43	1.54	0.45	0.74	0.80	0.72	0.38	1.16	2.51	1.67	0.92
18	3.07	4.29	2.55	1.19	2.68	3.73	2.27	1.16	0.50	0.65	0.75	0.38	1.18	2.33	1.78	0.94
19	3.16	5.84	3.25	1.34	2.77	4.53	2.94	1.39	0.55	0.58	0.59	0.40	1.12	2.38	1.85	1.04
20	4.07	9.64	2.54	0.97	3.51	6.59	2.56	1.25	0.61	0.69	0.64	0.50	1.36	2.58	1.83	0.99
Mean	3.49	6.35	2.29	0.77	3.04	4.67	2.21	0.92	0.54	0.59	0.59	0.37	1.24	2.39	1.72	0.89

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Table C.6.5 Maximum uplift forces of 6-storey building in E-W direction (with GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4- method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	77.1	53.8	46.9	22.3	8.7	1.3	134.0	94.2	57.5	29.4	11.3	1.6	94.7	56.0	55.4	37.9	25.6	12.6	37.2	40.8	35.6	32.4	18.2	8.3
2	103.5	59.2	42.5	22.0	9.9	2.2	114.1	87.1	62.9	35.2	14.8	3.0	77.8	50.0	45.8	23.9	16.1	8.9	46.0	46.6	38.0	31.3	17.2	5.6
3	72.9	49.2	40.9	25.4	10.0	4.2	84.2	67.3	49.3	31.8	14.6	2.2	137.3	82.0	77.0	46.0	28.4	10.2	44.8	41.9	35.1	34.5	21.7	8.4
4	78.6	58.3	41.8	24.6	9.3	0.3	104.8	69.4	50.5	30.6	11.4	0.4	97.8	55.9	62.4	42.2	29.7	14.3	40.5	43.5	33.2	32.6	18.9	8.6
5	96.0	60.1	32.2	13.7	4.5	0.0	108.3	71.6	38.1	16.5	4.9	0	84.7	51.5	51.0	35.6	22.9	9.7	33.5	35.3	28.4	22.1	14.8	7.3
6	88.7	56.8	44.5	22.7	8.9	0.0	126.4	91.3	57.6	32.1	11.1	0.1	112.2	66.5	66.4	37.2	24.2	11.9	34.0	34.1	28.1	22.7	15.7	7.0
7	130.8	63.6	44.4	22.2	7.4	0.0	140.7	102.4	65.1	34.2	11.1	0.0	46.0	26.4	25.2	17.7	13.5	6.7	30.9	32.0	21.5	15.5	8.2	3.8
8	50.2	62.0	47.1	26.2	11.1	2.3	113.3	92.7	68.6	41.4	17.8	3.5	89.9	58.9	55.0	35.3	31.3	15.1	31.7	35.5	28.0	29.5	17.1	7.0
9	109.4	73.0	45.9	24.0	6.6	0.0	126.0	92.6	57.1	30.4	8.5	0	122.7	70.9	65.2	40.7	26.5	10.2	37.5	35.3	27.5	22.0	12.9	5.7
10	106.3	66.8	36.4	20.8	5.0	0.0	121.2	86.3	53.5	28.4	6.9	0	92.0	52.6	48.8	29.2	17.8	8.8	33.0	28.4	21.6	17.7	9.4	5.6
11	122.8	73.7	46.2	23.2	8.9	0.6	137.2	101.5	67.9	36.6	13.1	0.8	111.4	67.0	69.0	43.4	26.4	10.6	38.8	38.5	29.6	25.3	13.7	5.6
12	69.7	52.8	39.2	23.4	8.9	0.4	80.0	64.5	48.6	29.0	12.3	0.5	92.1	57.1	55.8	39.6	33.1	16.4	42.8	44.3	33.6	29.7	20.1	9.6
13	80.2	51.7	35.4	18.0	4.6	0.0	88.3	60.7	40.4	21.6	5.6	0	126.5	77.4	72.7	42.1	25.2	13.5	33.0	31.0	24.9	22.2	16.6	8.5
14	73.9	46.6	30.1	12.5	7.5	0.3	86.2	57.6	35.3	14.7	8.5	0.4	112.9	71.7	69.3	45.2	26.6	14.4	52.9	44.9	34.5	23.6	15.8	8.2
15	90.1	55.3	42.1	22.0	8.2	0.4	134.3	97.2	61.5	35.0	12.7	0.5	107.5	65.4	65.3	45.6	27.0	14.2	45.1	46.9	35.0	26.9	21.1	9.4
16	89.3	58.2	41.5	21.7	8.5	0.0	101.3	74.4	48.1	27.2	10.7	0.1	78.4	44.1	46.1	30.0	26.5	12.1	29.9	32.1	26.5	20.1	12.7	7.4
17	80.0	40.8	27.1	12.5	1.7	0.0	90.1	54.9	33.6	16.3	2.1	0	104.6	62.4	61.5	36.6	21.9	12.0	31.5	31.4	24.1	22.1	12.1	6.5
18	70.8	63.9	41.2	20.3	12.3	1.5	108.9	80.9	51.6	27.1	14.1	1.9	62.4	40.1	45.3	30.1	23.0	11.9	29.2	31.9	27.1	24.8	14.8	6.9
19	75.0	54.1	49.6	26.3	13.1	3.7	87.2	67.0	58.4	40.3	20.3	5.7	81.0	60.3	63.3	39.9	30.9	20.1	30.8	37.9	32.3	32.1	20.2	8.2
20	97.3	67.3	47.3	24.7	8.1	1.5	132.9	100.9	71.4	40.2	14.7	2.5	68.6	45.6	48.6	30.7	23.4	11.9	37.8	39.1	35.1	30.1	20.2	9.1
Mean	88.1	58.3	41.1	21.4	8.2	0.9	111.0	80.7	53.8	29.9	11.3	1.5	95.0	58.1	57.5	36.4	25.0	12.3	37.1	37.6	30.0	25.9	16.1	7.3

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Table C.6.6 Maximum uplift forces of 6-storey building in N-S direction (with GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	190.3	126.1	74.9	49.4	26.2	8.3	177.4	119	72.4	48.3	26.3	9.6	19.6	18.5	13.3	9.8	7.2	5.0	35.1	40.6	48.0	41.5	26.0	9.3
2	99.9	94.4	82.2	58.7	35.9	9.6	92.0	88.2	76.7	58.7	33.3	10.5	37.9	35.5	22.9	12.9	7.8	4.2	52.0	54.2	50.6	40.5	25.2	9.4
3	125.5	83.6	71.8	55.8	33.6	6.0	109.7	78.5	67.5	52.3	30.9	8.2	29.9	24.3	15.2	9.0	7.3	4.3	62.0	56.4	50.0	40.0	31.0	18.0
4	182.9	122.0	92.7	58.8	47.1	19.0	162.1	113.9	89.2	58.7	42.0	19.1	29.3	23.4	13.7	9.8	9.0	4.2	52.4	51.4	47.7	38.0	27.9	14.7
5	190.3	152.9	114.4	58.8	32.1	3.5	190.3	152.5	113.2	58.8	36.0	12.0	31.0	29.7	18.6	12.9	8.7	4.4	41.0	47.6	42.0	29.9	24.4	12.5
6	190.3	154.5	99.5	58.6	22.8	1.7	190.3	151.8	101.9	58.7	28.7	6.5	29.3	26.5	14.0	9.1	6.7	3.7	51.3	49.8	40.9	35.1	25.9	15.6
7	158.9	111.6	82.8	58.7	37.1	9.5	140.9	105.5	80.0	58.7	34.2	11.2	16.5	17.0	11.2	7.6	5.3	2.9	37.6	33.4	29.2	20.1	13.2	4.7
8	156.4	110.8	83.0	58.7	37.9	10.6	137.1	103.4	78.4	58.7	34.8	11.3	30.0	31.9	21.3	14.0	10.8	5.5	48.6	44.0	40.2	35.1	26.5	12.8
9	190.3	136.5	74.2	39.1	15.4	0.1	190.3	135.0	79.4	40.6	16.8	2.4	29.2	22.5	13.1	9.8	7.9	4.2	54.4	51.8	41.4	35.6	25.7	13.6
10	190.2	145.4	104.6	58.7	27.9	6.0	175.0	134.5	98.0	58.7	29.7	9.8	25.5	21.8	12.9	9.8	7.7	3.4	42.8	41.7	35.5	25.8	18.3	8.3
11	162.5	122.7	93.7	58.7	35.0	6.5	145.4	114.3	88.4	58.7	33.2	9.7	40.6	40.2	27.0	17.0	11.9	5.4	47.5	50.9	40.5	32.8	25.7	13.4
12	110.5	71.2	58.4	45.6	33.5	14.8	97.3	64.9	54.4	43.2	30.3	13.3	24.6	23.1	14.6	12.0	9.9	5.0	54.7	52.7	44.9	37.3	26.1	16.3
13	190.3	159.7	100.8	57.3	19.2	0.2	190.3	158.3	103.6	58.7	27.3	5.2	33.4	30.1	19.7	11.8	7.5	3.6	53.4	51.6	45.2	36.8	28.2	16.9
14	158.9	115.4	78.7	52.6	39.5	16.1	143.1	107.9	72.8	47.1	36.3	17.1	27.3	23.4	14.9	10.4	6.6	5.1	65.9	55.4	47.4	38.1	23.7	14.2
15	177.6	116.6	77.4	45.3	18.5	1.3	157.6	110.0	74.7	45.1	19.1	4.4	31.7	29.6	19.4	14.3	9.5	4.8	56.8	51.2	50.3	40.2	29.2	15.3
16	190.3	151.6	104.5	58.7	29.7	2.7	190.3	153.2	105.2	58.7	32.8	10.1	24.5	22.1	14.0	9.7	8.1	4.8	47.1	46.6	45.8	36.4	25.4	14.6
17	190.3	145.6	107.3	58.8	31.4	7.8	179.7	137.8	102.4	58.8	34.2	13.1	37.6	33.5	20.4	11.5	7.0	3.8	51.8	50.4	43.7	38.3	25.0	15.8
18	190.3	149.9	107.4	58.7	29.9	9.5	183.3	142.7	103.1	58.7	32.1	12.3	29.7	26.7	17.6	13.1	9.6	5.3	40.3	39.3	35.9	29.5	24.1	12.2
19	47.8	59.5	65.8	58.7	46.7	19.0	42.8	55.4	60.7	55.8	41.4	19.0	22.8	23.0	14.1	11.2	8.4	6.7	50.5	46.9	42.0	37.0	26.7	14.9
20	89.5	98.0	94.0	58.8	45.0	15.5	83.3	91.5	87.7	58.8	41.9	16.0	27.9	29.3	17.7	11.3	8.1	4.5	60.0	52.3	49.8	40.0	28.1	17.4
Mean	159.1	121.4	88.4	55.4	32.2	8.4	148.9	115.7	85.5	54.8	32.1	11.0	28.9	26.6	16.8	11.4	8.2	4.5	50.3	48.4	43.6	35.4	25.3	13.5

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Table C.6.7 Maximum uplift deformation of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4- method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	1.65	1.91	1.66	1.55	0.61	0.09	2.87	3.34	2.04	2.04	0.78	0.11	2.03	1.98	1.96	2.62	1.78	0.87	0.80	1.44	1.26	2.25	1.26	0.58
2	2.22	2.10	1.51	1.53	0.69	0.15	2.45	3.09	2.23	2.45	1.03	0.21	1.67	1.77	1.62	1.66	1.12	0.62	0.98	1.65	1.34	2.17	1.19	0.39
3	1.56	1.75	1.45	1.77	0.70	0.29	1.81	2.39	1.75	2.21	1.01	0.16	2.94	2.90	2.72	3.19	1.97	0.71	0.96	1.48	1.24	2.39	1.51	0.58
4	1.69	2.07	1.48	1.71	0.64	0.02	2.25	2.46	1.79	2.12	0.79	0.02	2.09	1.98	2.21	2.93	2.06	0.99	0.87	1.54	1.18	2.26	1.31	0.60
5	2.06	2.13	1.14	0.95	0.31	0.00	2.32	2.54	1.35	1.15	0.34	0	1.81	1.82	1.80	2.47	1.59	0.67	0.72	1.25	1.01	1.53	1.03	0.51
6	1.90	2.01	1.58	1.58	0.62	0.00	2.71	3.24	2.04	2.23	0.77	0.00	2.40	2.35	2.35	2.58	1.68	0.82	0.73	1.21	0.99	1.57	1.09	0.49
7	2.81	2.25	1.58	1.54	0.51	0.00	3.02	3.63	2.31	2.38	0.77	0.00	0.98	0.93	0.89	1.23	0.94	0.46	0.66	1.13	0.76	1.07	0.57	0.27
8	1.08	2.20	1.67	1.82	0.77	0.16	2.43	3.29	2.43	2.88	1.23	0.24	1.92	2.08	1.95	2.45	2.17	1.05	0.68	1.25	0.99	2.05	1.19	0.49
9	2.35	2.59	1.63	1.67	0.46	0.00	2.70	3.28	2.02	2.11	0.59	0	2.62	2.51	2.31	2.82	1.84	0.71	0.80	1.25	0.97	1.52	0.89	0.39
10	2.28	2.37	1.29	1.45	0.35	0.00	2.60	3.06	1.90	1.98	0.48	0	1.97	1.86	1.72	2.02	1.23	0.61	0.71	1.00	0.76	1.23	0.65	0.39
11	2.63	2.61	1.64	1.61	0.62	0.04	2.94	3.60	2.41	2.55	0.91	0.06	2.38	2.37	2.44	3.00	1.83	0.74	0.83	1.36	1.05	1.76	0.95	0.39
12	1.50	1.87	1.39	1.63	0.62	0.02	1.72	2.29	1.72	2.02	0.86	0.03	1.97	2.02	1.97	2.75	2.30	1.14	0.92	1.57	1.19	2.06	1.39	0.67
13	1.72	1.83	1.26	1.25	0.32	0.00	1.89	2.15	1.43	1.50	0.39	0	2.71	2.74	2.57	2.92	1.75	0.94	0.71	1.10	0.88	1.54	1.15	0.59
14	1.59	1.65	1.07	0.87	0.52	0.02	1.85	2.04	1.25	1.02	0.59	0.03	2.41	2.53	2.45	3.13	1.85	1.00	1.13	1.59	1.22	1.64	1.10	0.57
15	1.93	1.96	1.49	1.53	0.57	0.02	2.88	3.45	2.18	2.43	0.88	0.04	2.30	2.31	2.31	3.16	1.87	0.99	0.96	1.66	1.24	1.86	1.46	0.65
16	1.92	2.06	1.47	1.51	0.59	0.00	2.17	2.64	1.71	1.89	0.74	0.00	1.68	1.56	1.63	2.08	1.84	0.84	0.64	1.13	0.94	1.40	0.88	0.51
17	1.72	1.45	0.96	0.87	0.12	0.00	1.93	1.94	1.19	1.13	0.14	0	2.24	2.21	2.18	2.54	1.52	0.83	0.67	1.11	0.85	1.53	0.84	0.45
18	1.52	2.26	1.46	1.41	0.86	0.11	2.34	2.87	1.83	1.88	0.98	0.13	1.33	1.42	1.60	2.08	1.59	0.83	0.62	1.13	0.96	1.72	1.03	0.48
19	1.61	1.92	1.76	1.83	0.91	0.26	1.87	2.38	2.07	2.80	1.41	0.39	1.73	2.13	2.24	2.76	2.14	1.40	0.66	1.34	1.14	2.22	1.40	0.57
20	2.09	2.39	1.68	1.72	0.56	0.10	2.85	3.58	2.53	2.79	1.02	0.18	1.47	1.61	1.72	2.13	1.62	0.83	0.81	1.38	1.24	2.09	1.40	0.63
Mean	1.89	2.07	1.46	1.49	0.57	0.06	2.38	2.86	1.91	2.08	0.79	0.11	2.03	2.05	2.03	2.53	1.73	0.85	0.79	1.33	1.06	1.79	1.11	0.51

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Table C.6.8 Maximum uplift deformation of 6-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	4.70	2.70	2.66	3.44	1.82	0.58	3.80	2.55	2.57	3.35	1.83	0.66	0.42	0.39	0.47	0.68	0.50	0.34	0.75	0.87	1.70	2.88	1.80	0.64
2	2.14	2.02	2.91	5.01	2.50	0.67	1.97	1.89	2.72	4.29	2.31	0.73	0.81	0.76	0.81	0.89	0.54	0.29	1.11	1.16	1.79	2.81	1.74	0.65
3	2.69	1.79	2.55	3.88	2.34	0.42	2.35	1.68	2.39	3.63	2.15	0.57	0.64	0.52	0.54	0.62	0.50	0.30	1.33	1.21	1.77	2.77	2.15	1.25
4	3.92	2.62	3.29	7.53	3.27	1.32	3.48	2.44	3.16	6.41	2.92	1.33	0.63	0.50	0.48	0.68	0.63	0.29	1.12	1.10	1.69	2.63	1.93	1.02
5	7.23	3.28	4.06	11.81	2.23	0.24	5.17	3.27	4.01	9.83	2.50	0.83	0.66	0.64	0.66	0.90	0.60	0.30	0.88	1.02	1.48	2.07	1.69	0.87
6	10.15	3.31	3.53	4.08	1.58	0.12	7.07	3.26	3.61	4.16	1.99	0.45	0.63	0.57	0.50	0.63	0.46	0.26	1.10	1.06	1.45	2.43	1.79	1.08
7	3.41	2.39	2.93	4.67	2.58	0.66	3.02	2.26	2.83	4.09	2.37	0.78	0.35	0.36	0.40	0.53	0.37	0.20	0.80	0.71	1.03	1.39	0.92	0.32
8	3.35	2.38	2.94	5.76	2.63	0.74	2.94	2.22	2.78	4.88	2.42	0.78	0.64	0.68	0.75	0.97	0.75	0.38	1.04	0.94	1.42	2.44	1.84	0.89
9	7.57	2.93	2.63	2.72	1.07	0.01	4.78	2.89	2.82	2.82	1.16	0.16	0.63	0.48	0.46	0.68	0.55	0.29	1.16	1.11	1.46	2.46	1.78	0.94
10	4.23	3.12	3.71	6.85	1.94	0.42	3.75	2.88	3.47	5.18	2.07	0.68	0.54	0.47	0.46	0.68	0.53	0.23	0.91	0.89	1.26	1.79	1.27	0.57
11	3.48	2.63	3.32	6.29	2.43	0.45	3.12	2.45	3.14	5.45	2.30	0.68	0.87	0.86	0.95	1.18	0.83	0.38	1.02	1.09	1.43	2.27	1.78	0.93
12	2.37	1.53	2.07	3.17	2.33	1.02	2.09	1.39	1.93	3.00	2.10	0.93	0.53	0.49	0.52	0.83	0.69	0.34	1.17	1.13	1.59	2.58	1.81	1.13
13	13.17	3.42	3.57	3.98	1.34	0.01	9.75	3.39	3.67	4.25	1.90	0.36	0.71	0.64	0.70	0.82	0.52	0.25	1.14	1.10	1.60	2.55	1.95	1.17
14	3.41	2.48	2.79	3.65	2.75	1.12	3.07	2.31	2.58	3.27	2.52	1.19	0.58	0.50	0.53	0.72	0.46	0.35	1.41	1.19	1.67	2.64	1.65	0.99
15	3.81	2.50	2.74	3.15	1.28	0.09	3.38	2.36	2.65	3.13	1.33	0.31	0.68	0.63	0.69	0.99	0.66	0.33	1.22	1.09	1.78	2.79	2.02	1.06
16	9.93	3.25	3.70	6.98	2.06	0.19	7.27	3.29	3.73	6.14	2.28	0.70	0.52	0.47	0.50	0.67	0.56	0.34	1.01	1.00	1.62	2.53	1.76	1.01
17	4.74	3.12	3.81	10.72	2.18	0.54	3.85	2.95	3.63	8.53	2.37	0.91	0.80	0.72	0.72	0.80	0.49	0.26	1.11	1.08	1.55	2.65	1.74	1.09
18	5.18	3.21	3.81	7.28	2.08	0.66	3.93	3.06	3.66	5.71	2.23	0.85	0.64	0.57	0.62	0.91	0.67	0.37	0.86	0.84	1.27	2.05	1.67	0.84
19	1.02	1.28	2.33	4.36	3.24	1.32	0.92	1.19	2.15	3.88	2.88	1.32	0.49	0.49	0.50	0.78	0.58	0.47	1.08	1.00	1.48	2.57	1.85	1.03
20	1.92	2.10	3.33	9.51	3.13	1.08	1.79	1.96	3.11	7.82	2.91	1.11	0.60	0.63	0.63	0.78	0.56	0.31	1.28	1.12	1.76	2.77	1.95	1.20
Mean	4.92	2.60	3.13	5.74	2.24	0.58	3.88	2.49	3.03	4.99	2.23	0.77	0.62	0.57	0.59	0.79	0.57	0.31	1.08	1.04	1.54	2.45	1.75	0.93

Table C.6.9 Maximum uplift forces of 4-storey building in E-W direction (without GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4- method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	7.3	0.0	0.0	0.0	8.8	0	0	0	50.4	26.5	20.1	6.8	25.5	39.1	27.6	19.0
2	10.6	1.5	0.0	0.0	12.5	1.8	0	0	59.3	28.7	19.6	7.3	36.5	37.6	25.0	14.5
3	7.0	0.0	0.0	0.0	8.1	0	0	0	63.5	34.6	26.4	11.4	37.4	39.2	28.4	23.7
4	3.1	0.0	0.0	0.0	3.2	0	0	0	64.1	35.9	29.1	13.3	37.0	37.9	27.4	23.7
5	6.5	0.1	0.0	0.0	6.0	0.1	0	0	45.1	26.3	18.3	10.9	31.1	34.0	24.9	20.5
6	1.5	0.0	0.0	0.0	1.5	0	0	0	53.2	27.5	21.1	9.8	32.4	34.9	25.8	20.0
7	9.8	0.0	0.0	0.0	8.4	0	0	0	26.1	17.7	16.2	7.9	21.8	20.1	10.2	5.1
8	2.3	3.0	0.1	0.0	2.5	3.0	0.1	0	55.1	28.4	23.5	17.6	30.8	36.2	27.8	19.9
9	8.3	0.2	0.0	0.0	7.7	0.1	0	0	45.9	20.5	16.0	6.7	32.8	31.9	22.1	14.1
10	5.3	0.0	0.0	0.0	6.4	0	0	0	54.1	25.5	18.5	10.0	33.3	33.2	23.0	18.1
11	8.9	0.0	0.0	0.0	10.9	0	0	0	75.7	37.8	26.9	9.6	39.2	36.3	26.1	22.5
12	1.7	2.4	1.4	0.3	1.5	2.1	1.5	0.3	80.6	46.8	36.7	19.2	37.5	39.4	26.7	20.9
13	10.1	1.2	0.0	0.0	8.1	1.0	0	0	45.4	24.2	15.3	8.1	31.9	35.9	25.5	18.3
14	0.0	0.0	0.0	0.0	0	0	0	0	58.3	26.5	18.9	12.0	38.4	37.8	27.0	19.5
15	10.7	3.9	0.0	0.0	9.3	3.5	0	0	61.5	35.3	23.1	11.3	37.2	38.0	27.9	18.3
16	2.6	0.0	0.0	0.0	2.5	0	0	0	44.6	23.6	20.1	10.0	31.8	30.6	24.1	18.5
17	4.4	0.0	0.0	0.0	5.6	0	0	0	43.3	25.1	23.5	12.5	32.6	37.9	24.7	16.4
18	0.5	0.0	0.0	1.1	0.6	0	0	1.3	40.2	23.6	24.6	12.2	30.6	35.3	25.0	19.3
19	1.3	1.8	0.1	0.2	1.4	1.9	0.1	0.3	52.8	37.3	28.4	14.4	31.9	38.7	28.4	22.6
20	12.3	3.1	0.0	0.0	15.6	3.9	0	0	55.6	26.9	19.7	10.4	38.3	38.2	27.9	19.2
Mean	5.7	0.8	0.1	0.1	6.4	1.9	0.6	0.7	53.7	28.9	22.3	11.1	33.4	35.6	25.3	18.7

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Table C.6.10 Maximum uplift forces of 4-storey building in N-S direction (without GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	93.5	58.7	28.5	10.3	78.0	50.8	25.6	11.5	9.0	5.7	6.3	4.0	37.1	40.0	28.7	17.0
2	94.2	58.7	37.5	19.7	78.7	56.8	33.1	16.9	15.8	8.3	7.6	5.9	38.2	37.7	27.3	13.4
3	72.5	52.5	30.0	11.3	60.8	44.6	26.9	12.1	16.2	7.5	7.5	4.8	43.2	40.7	30.1	21.9
4	80.8	46.8	30.2	15.4	67.9	39.3	26.6	15.2	12.2	6.8	8.6	6.3	38.8	39.3	28.9	21.7
5	92.4	58.7	32.6	14.3	78.2	53.8	29.6	15.5	13.0	7.1	8.0	5.0	34.6	36.4	27.4	18.8
6	97.6	58.7	33.5	13.8	83.6	55.3	30.4	15.2	15.0	7.1	6.4	5.0	36.1	37.3	27.8	18.3
7	96.5	58.7	30.9	15.8	82.4	55.5	29.5	16.1	8.6	6.7	5.9	3.3	26.0	19.6	15.8	9.0
8	90.2	58.7	37.9	16.8	75.2	58.3	34.1	16.6	16.0	9.7	11.7	8.2	37.9	39.4	28.0	18.1
9	96.3	58.7	34.6	15.0	81.1	57.7	32.2	16.3	15.7	7.4	5.9	3.2	38.2	36.8	26.4	15.5
10	99.0	58.7	40.5	20.0	83.7	58.4	34.2	17.1	13.9	9.0	8.4	4.8	37.3	31.5	25.3	17.0
11	102.1	58.7	36.4	15.5	88.0	58.7	33.8	16.6	22.2	10.4	8.0	5.1	42.2	40.1	28.3	19.1
12	72.2	52.3	35.3	20.1	62.2	45.6	30.4	16.7	18.4	12.4	13.8	7.4	40.5	34.5	29.3	22.9
13	73.1	40.6	18.6	6.6	63.1	37.3	17.8	6.9	14.8	6.9	5.1	4.1	42.2	39.8	27.8	20.5
14	84.3	54.0	27.7	12.5	69.6	45.6	24.7	12.6	14.6	8.0	8.0	5.8	43.1	38.0	25.5	19.3
15	90.2	57.0	26.1	7.1	75.0	48.4	23.8	8.8	19.2	11.1	13.4	6.3	40.6	39.9	29.2	19.5
16	91.5	58.7	40.9	20.5	77.7	56.6	34.4	17.3	15.3	7.7	7.1	4.3	34.2	36.8	26.6	18.3
17	75.3	43.2	22.1	7.6	64.0	38.5	19.1	7.3	20.8	11.5	10.4	5.5	33.5	37.2	27.7	18.9
18	83.8	58.7	37.6	19.1	69.3	52.9	32.5	16.5	14.2	9.4	10.8	5.5	34.0	35.4	26.8	18.5
19	79.1	57.6	39.6	27.5	68.6	49.8	32.3	22.5	15.5	8.3	8.5	5.8	37.9	37.0	28.1	18.2
20	100.9	58.7	36.9	17.4	85.1	58.7	34.5	16.7	17.3	10.0	9.2	7.2	42.1	38.0	28.7	15.3
Mean	88.3	55.4	32.9	15.3	74.6	51.1	29.3	14.7	15.4	8.5	8.5	5.4	37.9	36.8	27.2	18.1

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Table C.6.11 Maximum uplift deformation of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4- method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	0.26	0.00	0.00	0.00	0.31	0	0	0	1.78	1.84	1.39	0.47	0.90	2.71	1.91	1.32
2	0.38	0.10	0.00	0.00	0.44	0.13	0	0	2.10	1.99	1.36	0.51	1.29	2.61	1.73	1.00
3	0.25	0.00	0.00	0.00	0.29	0	0	0	2.24	2.40	1.83	0.79	1.32	2.71	1.97	1.64
4	0.11	0.00	0.00	0.00	0.11	0	0	0	2.27	2.49	2.02	0.92	1.31	2.63	1.90	1.65
5	0.23	0.01	0.00	0.00	0.21	0.01	0	0	1.60	1.82	1.27	0.76	1.10	2.36	1.72	1.42
6	0.05	0.00	0.00	0.00	0.05	0	0	0	1.88	1.91	1.46	0.68	1.15	2.42	1.79	1.39
7	0.35	0.00	0.00	0.00	0.30	0	0	0	0.92	1.22	1.12	0.55	0.77	1.39	0.71	0.35
8	0.08	0.21	0.01	0.00	0.09	0.21	0.01	0	1.95	1.97	1.63	1.22	1.09	2.51	1.92	1.38
9	0.29	0.01	0.00	0.00	0.27	0.01	0	0	1.62	1.42	1.11	0.46	1.16	2.21	1.53	0.98
10	0.19	0.00	0.00	0.00	0.23	0	0	0	1.91	1.76	1.28	0.69	1.18	2.30	1.60	1.25
11	0.32	0.00	0.00	0.00	0.39	0	0	0	2.68	2.62	1.86	0.66	1.39	2.52	1.81	1.56
12	0.06	0.16	0.09	0.02	0.05	0.15	0.11	0.02	2.85	3.24	2.55	1.33	1.33	2.73	1.85	1.45
13	0.36	0.08	0.00	0.00	0.29	0.07	0	0	1.60	1.68	1.06	0.56	1.13	2.49	1.77	1.27
14	0.00	0.00	0.00	0.00	0	0	0	0	2.06	1.84	1.31	0.83	1.36	2.62	1.87	1.35
15	0.38	0.27	0.00	0.00	0.33	0.24	0	0	2.17	2.44	1.60	0.78	1.31	2.63	1.93	1.27
16	0.09	0.00	0.00	0.00	0.09	0	0	0	1.58	1.64	1.40	0.69	1.12	2.12	1.67	1.28
17	0.16	0.00	0.00	0.00	0.20	0	0	0	1.53	1.74	1.63	0.86	1.15	2.62	1.71	1.13
18	0.02	0.00	0.00	0.08	0.02	0	0	0.09	1.42	1.64	1.71	0.84	1.08	2.45	1.73	1.34
19	0.04	0.12	0.01	0.01	0.05	0.13	0.01	0.02	1.87	2.58	1.97	0.99	1.13	2.68	1.97	1.57
20	0.44	0.22	0.00	0.00	0.55	0.27	0	0	1.97	1.86	1.36	0.72	1.35	2.65	1.93	1.33
Mean	0.20	0.06	0.01	0.01	0.23	0.14	0.04	0.05	1.90	2.01	1.55	0.77	1.18	2.47	1.75	1.30

Table C.6.12 Maximum uplift deformation of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	3.32	4.20	1.98	0.72	2.77	3.53	1.78	0.80	0.32	0.39	0.44	0.28	1.31	2.77	1.99	1.18
2	3.34	5.74	2.61	1.37	2.79	3.95	2.30	1.18	0.56	0.57	0.53	0.41	1.35	2.61	1.89	0.93
3	2.57	3.65	2.09	0.78	2.16	3.10	1.87	0.84	0.57	0.52	0.52	0.33	1.53	2.82	2.09	1.52
4	2.86	3.25	2.10	1.07	2.41	2.73	1.85	1.06	0.43	0.47	0.59	0.44	1.37	2.72	2.00	1.51
5	3.27	4.73	2.27	1.00	2.77	3.74	2.05	1.07	0.46	0.49	0.55	0.35	1.22	2.52	1.90	1.31
6	3.46	5.57	2.33	0.96	2.96	3.84	2.11	1.06	0.53	0.49	0.44	0.34	1.28	2.58	1.92	1.27
7	3.42	5.46	2.15	1.10	2.92	3.86	2.05	1.12	0.31	0.47	0.41	0.23	0.92	1.36	1.10	0.62
8	3.20	6.02	2.64	1.17	2.67	4.05	2.37	1.16	0.57	0.67	0.81	0.57	1.34	2.73	1.94	1.25
9	3.41	5.65	2.40	1.04	2.88	4.01	2.24	1.13	0.56	0.51	0.41	0.22	1.35	2.55	1.83	1.07
10	3.51	6.77	2.82	1.39	2.97	4.06	2.37	1.19	0.49	0.62	0.58	0.33	1.32	2.18	1.76	1.18
11	3.62	7.25	2.53	1.08	3.12	4.54	2.35	1.15	0.79	0.72	0.55	0.36	1.49	2.78	1.96	1.32
12	2.56	3.63	2.45	1.40	2.21	3.17	2.11	1.16	0.65	0.86	0.96	0.51	1.43	2.39	2.03	1.58
13	2.59	2.82	1.29	0.46	2.24	2.59	1.24	0.48	0.52	0.48	0.36	0.28	1.49	2.76	1.92	1.42
14	2.99	3.75	1.92	0.87	2.47	3.17	1.71	0.88	0.51	0.55	0.56	0.40	1.53	2.63	1.77	1.33
15	3.20	3.96	1.81	0.49	2.66	3.37	1.66	0.61	0.68	0.77	0.93	0.44	1.44	2.76	2.03	1.35
16	3.24	6.64	2.84	1.42	2.75	3.93	2.39	1.20	0.54	0.54	0.49	0.30	1.21	2.55	1.84	1.27
17	2.67	3.00	1.54	0.53	2.27	2.67	1.33	0.51	0.74	0.80	0.72	0.38	1.19	2.58	1.92	1.31
18	2.97	4.75	2.61	1.33	2.46	3.68	2.26	1.15	0.50	0.65	0.75	0.38	1.20	2.46	1.86	1.28
19	2.80	4.00	2.75	1.91	2.43	3.46	2.24	1.56	0.55	0.58	0.59	0.40	1.34	2.57	1.95	1.26
20	3.58	7.47	2.56	1.21	3.02	4.52	2.40	1.16	0.61	0.69	0.64	0.50	1.49	2.64	1.99	1.06
Mean	3.13	4.91	2.28	1.06	2.65	3.60	2.03	1.02	0.54	0.59	0.59	0.37	1.34	2.55	1.88	1.25

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Table C.6.13 Maximum uplift forces of 6-storey building in E-W direction (without GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4- method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	52.9	27.3	16.5	6.0	0.0	0.0	62.0	37.2	17.7	6.3.	0	0	94.7	56.0	55.4	37.9	25.6	12.6	35.6	31.5	39.2	38.3	25.5	12.4
2	50.8	26.0	18.5	6.8	0.0	0.0	37.7	31.2	22.5	8.9	0	0	77.8	50.0	45.8	23.9	16.1	8.9	42.4	46.4	41.5	38.4	25.2	14.1
3	30.3	26.8	29.6	10.8	2.3	0.5	31.6	26.6	22.7	11.9	2.3	0.7	137.3	82.0	77.0	46.0	28.4	10.2	54.3	53.1	40.6	39.1	30.2	25.7
4	48.1	26.8	10.2	0.0	0.0	0.0	61.1	35.9	12.5	0	0	0	97.8	55.9	62.4	42.2	29.7	14.3	45.2	49.5	41.4	38.5	26.2	17.6
5	56.5	33.0	17.1	4.9	0.0	0.0	76.9	48.5	23.4	6.0	0	0	84.7	51.5	51.0	35.6	22.9	9.7	36.8	42.8	36.7	37.0	26.1	22.2
6	47.3	25.1	9.2	0.6	0.0	0.0	61.1	34.1	11.0	0.6	0	0	112.2	66.5	66.4	37.2	24.2	11.9	44.6	45.8	37.7	36.8	26.3	22.3
7	45.5	25.6	17.1	3.1	0.0	0.0	48.4	27.1	15.5	3.7	0	0	46.0	26.4	25.2	17.7	13.5	6.7	38.1	41.0	26.0	20.5	12.0	7.4
8	32.6	22.7	10.2	0.6	0.0	0.0	41.4	23.5	9.2	0.5	0	0	89.9	58.9	55.0	35.3	31.3	15.1	47.4	45.0	36.2	35.6	27.9	19.7
9	46.0	22.9	8.9	0.0	0.0	0.0	63.6	33.8	9.9	0	0	0	122.7	70.9	65.2	40.7	26.5	10.2	49.5	49.4	39.3	33.7	23.9	19.2
10	52.9	32.6	14.3	4.1	0.0	0.0	64.5	44.4	21.2	5.9	0	0	92.0	52.6	48.8	29.2	17.8	8.8	37.0	35.6	30.4	28.4	19.7	13.5
11	50.3	33.1	21.4	9.4	2.1	0.0	53.1	37.2	28.0	12.8	2.6	0.0	111.4	67.0	69.0	43.4	26.4	10.6	37.0	39.4	35.7	35.0	23.9	19.9
12	30.2	20.7	11.4	1.7	0.0	0.0	29.8	19.3	11.3	1.7	0	0	92.1	57.1	55.8	39.6	33.1	16.4	43.4	48.5	37.6	35.3	22.2	20.6
13	60.1	35.4	19.8	6.8	0.0	0.0	80.7	50.2	24.9	8.3	0	0	126.5	77.4	72.7	42.1	25.2	13.5	52.1	49.4	39.0	35.9	25.5	19.5
14	44.3	39.0	12.9	0.5	0.0	0.0	59.6	33.4	11.8	0.5	0	0	112.9	71.7	69.3	45.2	26.6	14.4	52.3	49.7	38.6	39.4	26.5	20.2
15	36.6	22.4	9.6	2.3	0.0	0.0	40.0	25.4	10.1	2.2	0	0	107.5	65.4	65.3	45.6	27.0	14.2	52.0	51.9	39.1	38.2	28.7	19.3
16	64.3	31.4	13.4	3.7	0.0	0.0	53.9	32.4	15.1	3.8	0	0	78.4	44.1	46.1	30.0	26.5	12.1	45.5	46.3	35.9	33.5	24.5	20.7
17	60.6	37.2	14.9	2.2	0.0	0.0	65.2	41.6	18.7	3.0	0	0	104.6	62.4	61.5	36.6	21.9	12.0	44.4	48.2	40.3	38.9	26.2	21.0
18	56.2	30.5	14.2	2.1	0.0	0.0	57.2	37.1	18.0	2.5	0	0	62.4	40.1	45.3	30.1	23.0	11.9	39.8	39.3	32.4	31.7	21.4	17.1
19	0.0	0.0	0.0	0.0	3.8	0.9	0	0	0	0	4.5	1.7	81.0	60.3	63.3	39.9	30.9	20.1	41.6	43.3	37.0	36.4	28.0	21.9
20	34.0	31.4	28.5	10.1	2.1	0.0	30.6	27.8	23.3	13.2	2.8	0	68.6	45.6	48.6	30.7	23.4	11.9	50.4	53.1	37.6	37.9	29.0	23.3
Mean	45.0	27.5	14.9	3.8	0.5	0.1	53.6	34.0	17.2	5.4	3.0	0.8	95.0	58.1	57.5	36.4	25.0	12.3	44.5	45.5	37.1	35.4	24.9	18.9

Table C.6.14 Maximum uplift forces of 6-storey building in N-S direction (without GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	184.6	123.8	71.7	50.3	29.1	10.8	163.3	113.6	67.1	47.0	26.1	11.5	19.6	18.5	13.3	9.8	7.2	5.0	38.3	33.0	34.0	36.3	28.6	18.3
2	99.3	87.4	79.6	58.7	36.5	13.9	84.2	79.7	71.1	58.5	34.4	15.6	37.9	35.5	22.9	12.9	7.8	4.2	49.5	51.9	50.0	42.8	28.7	12.5
3	132.4	80.1	52.7	41.8	29.2	10.8	114.2	72.1	48.9	38.7	26.0	11.1	29.9	24.3	15.2	9.0	7.3	4.3	67.7	67.1	54.0	44.2	32.1	23.6
4	188.3	129.8	85.2	56.1	40.3	17.9	167.2	119.2	78.8	48.0	35.8	17.9	29.3	23.4	13.7	9.8	9.0	4.2	52.5	54.0	49.4	42.9	30.0	21.7
5	171.7	125.5	89.0	58.7	30.9	9.3	153.6	114.8	81.0	56.2	28.7	11.4	31.0	29.7	18.6	12.9	8.7	4.4	42.6	47.5	47.6	38.6	27.4	17.8
6	190.2	142.7	104.6	58.8	39.7	16.3	175.2	132.8	98.0	58.8	37.6	18.7	29.3	26.5	14.0	9.1	6.7	3.7	56.8	53.0	45.7	37.3	25.3	16.7
7	143.0	90.4	72.6	55.7	32.9	14.6	123.6	83.6	67.7	51.1	29.8	15.1	16.5	17.0	11.2	7.6	5.3	2.9	53.4	40.9	32.4	28.1	20.8	13.4
8	139.7	103.8	84.6	58.7	38.4	14.4	122.2	94.2	77.3	58.7	36.1	16.7	30.0	31.9	21.3	14.0	10.8	5.5	55.0	56.2	48.4	42.4	29.2	17.9
9	190.3	131.5	73.7	38.5	18.2	4.7	176.3	122.5	74.8	39.8	19.1	5.5	29.2	22.5	13.1	9.8	7.9	4.2	60.9	58.6	49.6	38.0	24.8	15.5
10	163.2	121.7	88.3	58.7	25.6	4.9	145.7	111.1	80.2	51.6	24.2	6.9	25.5	21.8	12.9	9.8	7.7	3.4	43.4	45.9	42.8	33.0	23.3	14.6
11	150.4	86.8	66.4	46.7	29.9	8.8	130.7	78.9	61.6	44.3	26.9	10.1	40.6	40.2	27.0	17.0	11.9	5.4	50.3	48.7	46.0	41.2	27.5	14.0
12	100.7	64.2	52.1	43.3	34.8	17.9	89.6	59.9	48.0	39.6	30.3	15.7	24.6	23.1	14.6	12.0	9.9	5.0	48.0	51.9	44.9	35.1	28.9	21.0
13	190.3	163.5	107.4	58.7	24.3	5.5	190.3	153.7	103.4	58.7	29.3	12.8	33.4	30.1	19.7	11.8	7.5	3.6	60.9	59.6	48.8	39.6	28.3	18.6
14	167.7	117.1	76.3	45.8	32.8	20.2	146.8	106.3	71.8	42.7	29.2	18.0	27.3	23.4	14.9	10.4	6.6	5.1	65.3	61.0	51.3	43.4	28.2	18.9
15	148.9	101.5	81.9	58.7	26.0	6.1	129.4	93.2	74.2	51.9	24.4	6.9	31.7	29.6	19.4	14.3	9.5	4.8	52.7	54.4	50.4	43.9	30.0	19.1
16	190.3	150.6	104.8	58.7	27.5	10.3	184.5	140.5	98.9	57.6	28.3	14.5	24.5	22.1	14.0	9.7	8.1	4.8	48.6	48.2	46.6	34.2	24.9	15.8
17	187.0	128.4	90.9	58.7	38.9	17.0	165.0	116.4	83.1	58.7	36.6	18.3	37.6	33.5	20.4	11.5	7.0	3.8	45.5	55.0	49.0	41.3	28.6	21.6
18	169.5	118.8	88.5	58.7	27.0	13.4	147.4	110.2	80.5	52.7	25.1	12.6	29.7	26.7	17.6	13.1	9.6	5.3	40.8	43.0	40.2	38.3	26.1	19.2
19	45.8	48.7	60.8	58.7	53.8	28.2	41.7	44.0	53.9	58.7	44.4	23.4	22.8	23.0	14.1	11.2	8.4	6.7	55.3	54.8	46.8	40.0	27.8	21.2
20	87.9	89.8	86.6	58.8	48.6	22.9	80.4	82.3	77.6	58.7	40.8	19.5	27.9	29.3	17.7	11.3	8.1	4.5	60.0	60.4	48.7	38.6	30.8	21.6
Mean	152.1	110.3	80.9	54.1	33.2	13.4	136.6	101.4	74.9	51.6	30.7	14.1	28.9	26.6	16.8	11.4	8.2	4.5	52.4	52.3	46.3	39.0	27.6	18.2

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Table C.6.15 Maximum uplift deformation of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4- method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	1.14	0.97	0.59	0.42	0.00	0.00	1.33	1.32	0.63	0.44	0	0	2.03	1.98	1.96	2.62	1.78	0.87	0.76	1.11	1.39	2.65	1.77	0.86
2	1.09	0.92	0.66	0.48	0.00	0.00	0.81	1.10	0.80	0.62	0	0	1.67	1.77	1.62	1.66	1.12	0.62	0.91	1.64	1.47	2.66	1.75	0.98
3	0.65	0.95	1.05	0.75	0.16	0.04	0.68	0.94	0.80	0.82	0.16	0.05	2.94	2.90	2.72	3.19	1.97	0.71	1.16	1.88	1.44	2.71	2.09	1.78
4	1.03	0.95	0.36	0.00	0.00	0.00	1.31	1.27	0.44	0	0	0	2.09	1.98	2.21	2.93	2.06	0.99	0.97	1.75	1.46	2.67	1.81	1.22
5	1.21	1.17	0.61	0.34	0.00	0.00	1.65	1.72	0.83	0.42	0	0	1.81	1.82	1.80	2.47	1.59	0.67	0.79	1.51	1.30	2.56	1.81	1.54
6	1.01	0.89	0.33	0.04	0.00	0.00	1.31	1.21	0.39	0.04	0	0	2.40	2.35	2.35	2.58	1.68	0.82	0.95	1.62	1.33	2.55	1.82	1.55
7	0.98	0.91	0.61	0.21	0.00	0.00	1.04	0.96	0.55	0.26	0	0	0.98	0.93	0.89	1.23	0.94	0.46	0.82	1.45	0.92	1.42	0.83	0.51
8	0.70	0.80	0.36	0.04	0.00	0.00	0.89	0.83	0.33	0.03	0	0	1.92	2.08	1.95	2.45	2.17	1.05	1.01	1.59	1.28	2.47	1.94	1.37
9	0.99	0.81	0.31	0.00	0.00	0.00	1.36	1.20	0.35	0	0	0	2.62	2.51	2.31	2.82	1.84	0.71	1.06	1.75	1.39	2.34	1.66	1.33
10	1.13	1.15	0.51	0.29	0.00	0.00	1.38	1.57	0.75	0.41	0	0	1.97	1.86	1.72	2.02	1.23	0.61	0.79	1.26	1.07	1.97	1.37	0.94
11	1.08	1.17	0.76	0.66	0.15	0.00	1.14	1.32	0.99	0.89	0.18	0.00	2.38	2.37	2.44	3.00	1.83	0.74	0.79	1.39	1.26	2.43	1.66	1.38
12	0.65	0.73	0.40	0.12	0.00	0.00	0.64	0.68	0.40	0.12	0	0	1.97	2.02	1.97	2.75	2.30	1.14	0.93	1.71	1.33	2.45	1.54	1.43
13	1.29	1.25	0.70	0.47	0.00	0.00	1.73	1.78	0.88	0.57	0	0	2.71	2.74	2.57	2.92	1.75	0.94	1.11	1.75	1.38	2.49	1.77	1.35
14	0.95	1.38	0.46	0.04	0.00	0.00	1.28	1.18	0.42	0.03	0	0	2.41	2.53	2.45	3.13	1.85	1.00	1.12	1.76	1.36	2.73	1.84	1.40
15	0.78	0.79	0.34	0.16	0.00	0.00	0.86	0.90	0.36	0.15	0	0	2.30	2.31	2.31	3.16	1.87	0.99	1.11	1.84	1.38	2.65	1.99	1.34
16	1.38	1.12	0.47	0.25	0.00	0.00	1.16	1.15	0.54	0.26	0	0	1.68	1.56	1.63	2.08	1.84	0.84	0.97	1.64	1.27	2.32	1.70	1.44
17	1.30	1.32	0.53	0.15	0.00	0.00	1.40	1.47	0.66	0.21	0	0	2.24	2.21	2.18	2.54	1.52	0.83	0.95	1.70	1.43	2.70	1.81	1.46
18	1.21	1.08	0.50	0.14	0.00	0.00	1.23	1.32	0.64	0.17	0	0	1.33	1.42	1.60	2.08	1.59	0.83	0.85	1.39	1.14	2.20	1.48	1.18
19	0.00	0.00	0.00	0.00	0.26	0.07	0	0	0	0	0.31	0.12	1.73	2.13	2.24	2.76	2.14	1.40	0.89	1.53	1.31	2.52	1.94	1.52
20	0.73	1.11	1.01	0.70	0.15	0.00	0.66	0.99	0.83	0.92	0.20	0	1.47	1.61	1.72	2.13	1.62	0.83	1.08	1.88	1.33	2.63	2.01	1.62
Mean	0.96	0.97	0.53	0.26	0.04	0.01	1.15	1.21	0.61	0.37	0.21	0.06	2.03	2.05	2.03	2.53	1.73	0.85	0.95	1.61	1.31	2.46	1.73	1.31

Table C.6.16 Maximum uplift deformation of 6-storey building in N-S direction (without GWB), mm

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	3.96	2.66	2.54	3.49	2.02	0.75	3.50	2.44	2.38	3.27	1.82	0.80	0.42	0.39	0.47	0.68	0.50	0.34	0.82	0.71	1.20	2.51	1.98	1.27
2	2.13	1.87	2.82	5.38	2.54	0.96	1.81	1.71	2.52	4.06	2.39	1.08	0.81	0.76	0.81	0.89	0.54	0.29	1.06	1.11	1.77	2.97	1.99	0.86
3	2.84	1.72	1.87	2.90	2.03	0.75	2.45	1.55	1.73	2.69	1.81	0.77	0.64	0.52	0.54	0.62	0.50	0.30	1.45	1.44	1.91	3.06	2.22	1.64
4	4.04	2.78	3.02	3.90	2.80	1.25	3.59	2.56	2.79	3.34	2.49	1.24	0.63	0.50	0.48	0.68	0.63	0.29	1.12	1.15	1.75	2.98	2.08	1.50
5	3.68	2.69	3.16	4.91	2.15	0.65	3.29	2.46	2.87	3.91	2.00	0.79	0.66	0.64	0.66	0.90	0.60	0.30	0.91	1.02	1.68	2.67	1.90	1.23
6	4.35	3.06	3.71	11.70	2.76	1.14	3.76	2.85	3.48	7.91	2.61	1.30	0.63	0.57	0.50	0.63	0.46	0.26	1.21	1.13	1.61	2.59	1.76	1.16
7	3.07	1.94	2.57	3.87	2.29	1.02	2.65	1.79	2.40	3.55	2.07	1.05	0.35	0.36	0.40	0.53	0.37	0.20	1.14	0.87	1.15	1.95	1.44	0.93
8	3.00	2.23	3.00	6.11	2.67	1.00	2.62	2.02	2.74	4.58	2.51	1.16	0.64	0.68	0.75	0.97	0.75	0.38	1.18	1.20	1.71	2.94	2.02	1.24
9	4.89	2.82	2.61	2.68	1.27	0.33	3.78	2.63	2.65	2.77	1.32	0.38	0.63	0.48	0.46	0.68	0.55	0.29	1.30	1.25	1.75	2.64	1.72	1.07
10	3.50	2.61	3.13	4.09	1.78	0.34	3.12	2.38	2.84	3.59	1.68	0.48	0.54	0.47	0.46	0.68	0.53	0.23	0.93	0.98	1.51	2.29	1.62	1.01
11	3.23	1.86	2.35	3.24	2.08	0.61	2.80	1.69	2.18	3.08	1.87	0.70	0.87	0.86	0.95	1.18	0.83	0.38	1.08	1.04	1.63	2.85	1.91	0.97
12	2.16	1.38	1.85	3.01	2.42	1.25	1.92	1.28	1.70	2.75	2.11	1.09	0.53	0.49	0.52	0.83	0.69	0.34	1.03	1.11	1.59	2.44	2.00	1.46
13	12.02	3.51	3.81	4.28	1.69	0.38	6.80	3.30	3.67	4.42	2.03	0.89	0.71	0.64	0.70	0.82	0.52	0.25	1.30	1.27	1.72	2.74	1.96	1.29
14	3.60	2.51	2.71	3.18	2.28	1.40	3.15	2.28	2.55	2.96	2.03	1.25	0.58	0.50	0.53	0.72	0.46	0.35	1.40	1.31	1.81	3.00	1.96	1.31
15	3.19	2.18	2.90	4.14	1.80	0.42	2.77	2.00	2.63	3.61	1.70	0.48	0.68	0.63	0.69	0.99	0.66	0.33	1.13	1.16	1.78	3.04	2.08	1.32
16	5.34	3.23	3.72	5.40	1.91	0.71	3.96	3.01	3.51	4.00	1.97	1.01	0.52	0.47	0.50	0.67	0.56	0.34	1.04	1.03	1.65	2.37	1.72	1.10
17	4.01	2.75	3.22	6.44	2.70	1.18	3.54	2.50	2.95	4.57	2.54	1.27	0.80	0.72	0.72	0.80	0.49	0.26	0.97	1.18	1.73	2.86	1.98	1.50
18	3.64	2.55	3.14	4.30	1.87	0.93	3.16	2.36	2.85	3.66	1.74	0.87	0.64	0.57	0.62	0.91	0.67	0.37	0.87	0.92	1.42	2.65	1.81	1.33
19	0.98	1.04	2.15	5.43	3.74	1.96	0.89	0.94	1.91	4.09	3.09	1.63	0.49	0.49	0.50	0.78	0.58	0.47	1.18	1.17	1.66	2.77	1.92	1.47
20	1.89	1.93	3.07	8.51	3.38	1.59	1.72	1.76	2.75	5.73	2.84	1.35	0.60	0.63	0.63	0.78	0.56	0.31	1.28	1.29	1.72	2.67	2.14	1.50
Mean	3.77	2.37	2.87	4.85	2.31	0.93	3.06	2.18	2.66	3.93	2.13	0.98	0.62	0.57	0.59	0.79	0.57	0.31	1.12	1.12	1.64	2.70	1.91	1.26

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Appendix D

Results of Representative Wood-Frame Buildings Designed in Accordance with 2010 NBCC

D.1 Fundamental period of the Building

	4-storey building (s)		6-storey building (s)	
	E-W	N-S	E-W	N-S
Drain-3D	0.54	0.68	0.78	0.96
SAPWood	0.52		0.66	

D.2 Maximum base shear

No.	4-storey building (kN)				6-storey building (kN)			
	Drain-3D		SAPWood		Drain-3D		SAPWood	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
1	1411	1065	883	844	1713	1656	1066	761
2	1426	1048	785	908	1682	1644	1099	972
3	1477	1044	1179	905	1663	1527	833	957
4	1388	1028	1336	889	1687	1602	1244	943
5	1222	1077	864	784	1737	1563	887	936
6	1358	1058	814	755	1734	1590	739	893
7	1205	1098	667	583	1765	1648	1141	1006
8	1257	1024	777	1029	1642	1612	878	985
9	1468	1077	907	813	1676	1492	966	1032
10	1319	1002	822	708	1658	1652	675	679
11	1332	963	951	807	1446	1760	752	669
12	1262	1062	1225	703	1738	1708	1175	1003
13	1279	1056	686	807	1708	1603	782	847
14	1401	1005	986	1045	1340	1116	1267	1203
15	1298	1096	991	921	1722	1584	1172	931
16	1323	1033	746	705	1589	1583	641	864
17	1503	1065	539	704	1756	1517	750	800
18	1530	1120	1094	759	1621	1456	971	902
19	1194	1038	1209	1030	1607	1703	1426	1277
20	1366	1096	1298	1144	1815	1635	1278	1099
Mean	1351	1053	938	842	1665	1583	987	938

D.3 Maximum displacement and acceleration at each storey

Table D.3.1 Maximum displacements of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	33.7	58.4	72.9	79.9	35.4	56.6	71.7	78.5	23.0	36.8	48.5	51.3
2	34.9	57.7	71.4	78.9	39.3	59.2	72.6	78.8	32.6	49.5	60.5	63.2
3	32.4	57.5	70.9	77.3	34.7	56.0	69.7	76.1	18.4	43.6	58.3	64.4
4	18.2	37.0	54.2	62.4	16.4	32.0	49.7	57.7	20.8	41.1	55.9	61.7
5	24.2	37.5	46.6	53.0	25.5	37.8	45.9	49.9	9.8	19.0	25.8	28.9
6	15.8	29.0	39.8	45.3	15.0	26.6	37.3	42.7	10.9	21.8	30.1	33.6
7	41.0	70.5	84.5	91.6	42.3	68.8	82.9	90.1	33.3	50.3	61.9	64.7
8	24.2	45.1	65.2	74.0	28.5	45.8	65.4	73.1	21.7	44.9	60.0	64.6
9	18.8	32.9	45.2	51.9	21.4	33.9	45.9	52.4	11.0	20.1	28.0	30.9
10	22.1	37.2	48.5	55.6	23.3	36.2	47.7	53.5	10.0	19.2	25.9	28.9
11	37.1	56.9	73.9	83.2	38.6	57.8	71.1	79.1	16.0	30.9	45.9	52.7
12	44.0	68.3	85.5	94.0	46.6	69.7	87.8	96.7	17.7	36.2	50.4	58.3
13	15.8	29.6	41.9	48.5	17.0	29.3	41.8	48.2	11.3	19.3	25.0	27.1
14	24.4	37.1	45.8	50.6	25.6	36.9	46.2	50.9	21.5	31.8	36.3	38.1
15	32.3	54.3	68.1	75.4	31.8	49.0	61.3	67.6	16.9	32.9	46.8	51.8
16	19.1	33.8	45.9	52.5	20.2	33.0	44.0	49.7	9.9	19.0	26.3	29.0
17	26.7	41.5	52.7	59.3	27.6	40.8	51.6	58.3	13.9	25.2	35.4	39.0
18	19.5	35.0	48.3	56.9	21.5	35.9	49.5	56.7	11.4	22.2	33.9	37.8
19	29.4	53.3	71.3	80.0	31.7	51.0	68.7	76.8	15.3	31.3	49.0	52.9
20	27.8	55.8	79.6	88.5	30.0	54.3	78.1	86.6	26.6	48.4	65.9	70.6
Mean	27.1	46.4	60.6	67.9	28.6	45.5	59.4	66.2	17.6	32.2	43.5	47.5

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Table D.3.2 Maximum displacements of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	30.9	57.4	88.7	111.4	30.9	57.3	88.5	111.2	26.7	46.6	62.6	66.7
2	27.4	52.8	76.3	91.0	27.4	52.7	76.1	90.8	32.9	52.1	69.0	72.3
3	24.7	47.5	71.9	87.5	24.7	47.5	71.8	87.4	25.7	49.7	77.1	86.9
4	27.6	47.9	76.9	97.8	27.6	47.9	76.8	97.6	23.0	44.6	67.0	75.3
5	30.3	54.2	81.7	101.1	30.3	54.3	81.7	101	17.2	31.5	41.2	43.7
6	31.8	54.5	78.9	97.2	31.7	54.4	78.9	97.2	18.1	34.9	54.6	62.4
7	31.2	62.1	92.3	111.0	31.1	62.0	92.2	110.9	33.2	55.0	68.6	70.9
8	15.6	33.4	57.1	76.8	15.6	33.3	57.2	76.9	16.4	35.7	52.2	57.2
9	30.2	55.6	81.1	97.2	30.2	55.4	80.9	96.9	23.9	41.3	56.5	59.1
10	31.3	56.3	78.4	93.3	31.3	56.3	78.4	93.4	21.0	36.3	48.7	51.3
11	33.7	62.9	90.1	108.0	33.6	62.8	90.0	107.9	25.2	42.3	61.2	67.4
12	43.1	75.1	102.8	120.3	43.1	75.0	102.6	119.9	24.2	44.4	69.7	78.7
13	25.3	41.8	59.6	73.2	25.3	41.8	59.5	72.9	16.5	31.4	47.0	52.9
14	29.9	47.2	63.5	74.5	29.9	47.1	63.4	74.4	30.7	48.1	62.1	65.0
15	27.6	50.6	75.6	92.7	27.6	50.6	75.6	92.7	26.1	48.8	74.5	81.4
16	23.3	41.5	60.9	75.4	23.3	41.5	60.9	75.3	15.3	26.9	40.7	47.4
17	21.9	38.3	57.2	70.4	21.9	38.2	57.1	70.3	16.9	34.0	49.2	53.9
18	27.2	46.8	64.7	78.2	27.2	46.8	64.7	78.1	18.3	34.3	49.3	53.8
19	18.1	37.9	61.6	78.3	18.1	37.8	61.5	78.1	18.2	28.9	45.4	48.7
20	30.1	55.8	84.2	103.4	30.1	55.8	84.3	103.5	26.1	50.4	68.5	75.0
Mean	28.1	51.0	75.2	91.9	28.0	50.9	75.1	91.3	22.8	40.9	58.3	63.5

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Table D.3.3 Maximum displacements of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	20.6	41.4	62.7	87.1	109.9	122.0	18.8	36.6	67.4	91.1	112.9	124.8	18.1	32.2	45.3	64.6	77.7	81.5
2	17.0	33.9	52.3	69.7	86.3	96.7	17.6	33.4	54.4	69.1	85.9	96.7	14.6	32.4	46.5	60.5	73.2	76.0
3	18.4	36.5	56.5	74.3	89.7	99.2	17.7	34.8	60.7	77.7	92.7	102.3	25.4	43.8	62.3	81.7	111.8	121.7
4	20.7	40.3	67.7	93.3	115.9	127.3	20.5	36.9	70.9	95.0	116.7	128.0	22.2	38.4	50.4	61.2	81.1	87.8
5	21.8	43.0	64.1	82.5	98.0	107.9	22.3	39.6	63.0	79.5	94.2	103.8	13.7	25.1	35.5	46.1	57.8	61.3
6	23.5	45.7	65.9	83.4	97.7	106.9	22.3	40.2	61.6	77.8	92.4	102.0	17.0	33.4	45.4	58.4	74.1	79.9
7	18.0	37.7	63.6	86.8	106.8	118.1	17.2	35.0	65.0	84.7	102.3	114.0	23.1	42.8	57.9	69.4	77.4	79.4
8	12.3	26.3	44.9	65.9	87.7	100.2	12.8	27.1	45.8	64.8	86.1	98.8	17.0	31.0	46.1	59.3	66.1	66.8
9	21.2	43.4	69.0	90.6	107.5	117.6	20.8	40.5	72.0	93.1	112.0	123.1	22.2	37.2	52.0	65.5	75.8	78.2
10	18.7	36.7	56.7	74.0	88.7	98.4	20.2	37.0	57.3	72.8	87.4	97.4	15.3	27.8	40.3	49.5	55.8	57.6
11	22.3	45.4	70.3	92.4	110.8	122.0	24.2	43.6	73.3	90.1	105.1	117.1	14.0	30.1	44.9	60.5	73.2	76.1
12	21.4	44.2	68.2	87.7	103.9	114.0	21.7	42.3	71	89.0	105.2	116.0	18.5	33.8	47.3	56.7	71.8	77.7
13	16.8	32.7	50.2	65.5	79.1	87.5	14.8	29.5	46.1	60.2	73.2	81.6	18.0	32.2	44.9	60.5	77.5	83.7
14	24.7	42.3	58.5	71.5	80.9	87.4	23.9	40.6	57.4	69.8	79.6	86.8	26.5	41.5	52.2	62.4	69.9	73.1
15	19.3	38.3	58.1	77.0	94.8	105.6	16.7	33.1	56.4	74.0	92.0	103.6	22.2	40.4	56.7	75.9	93.4	98.8
16	17.0	35.0	57.3	77.7	94.9	104.9	16.5	32.8	58.6	77.6	94.9	105.3	15.1	28.1	41.5	52.5	62.2	64.2
17	17.2	32.6	48.5	61.3	71.8	79.4	16.2	30.5	44.9	56.4	66.0	72.4	15.4	30.9	44.3	58.5	72.4	78.1
18	18.1	35.5	53.4	71.8	89.9	101.2	18.7	35.8	56.5	71.9	86.3	96.0	12.6	22.9	33.0	41.8	54.6	57.0
19	11.9	24.8	37.9	51.9	68.4	77.9	12.2	25.4	39.3	52.4	70.6	80.7	16.4	28.9	35.7	43.0	49.9	52.3
20	16.1	34.9	58.1	79.5	98.4	109.8	16.5	34.7	60.0	80.3	99.7	111.7	25.4	43.6	55.1	54.9	68.3	72.8
Mean	18.8	37.5	58.2	77.2	94.1	104.2	18.6	35.5	58.5	76.4	92.8	103.1	18.6	33.8	46.9	59.1	72.2	76.2

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Table D.3.4 Maximum displacements of 6-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	25.7	49.1	71.9	93.0	114.0	129.1	25.7	49.0	71.9	93.0	114.0	129.1	14.2	29.1	43.2	56.7	66.4	70.8
2	16.8	31.3	45.2	64.2	97.1	122.6	16.7	31.2	45.0	63.9	96.7	122.0	15.7	32.0	47.1	56.9	65.5	69.5
3	26.7	43.8	61.8	87.6	123.0	147.9	26.7	43.8	61.6	87.4	122.7	147.4	16.4	28.9	45.6	63.6	78.3	84.3
4	20.7	41.4	62.0	83.4	118.0	146.8	20.7	41.4	62.0	83.4	118.0	146.8	14.1	27.2	41.6	54.8	66.3	71.5
5	22.4	45.0	76.9	119.5	164.7	199.0	22.4	45.0	76.8	119.4	164.6	198.9	12.4	23.0	33.4	40.8	46.9	50.1
6	28.2	55.3	86.0	120.4	149.5	171.9	28.1	55.1	85.8	120.1	149.2	171.5	11.5	22.5	32.6	41.5	51.1	56.0
7	21.7	38.9	55.6	76.5	104.1	125.6	21.6	38.8	55.6	76.5	104.2	125.8	17.6	32.8	48.8	61.3	70.2	74.8
8	19.8	41.9	67.3	96.8	127.0	150.5	19.8	41.8	67.2	96.7	126.9	150.4	10.8	22.6	35.0	46.1	54.6	59.1
9	31.2	57.6	88.5	125.4	157.1	181.0	31.1	57.5	88.1	124.9	156.5	180.2	14.7	27.9	40.7	49.7	55.9	59.4
10	19.5	39.0	66.5	103.0	146.6	178	19.5	38.8	66.4	102.8	146.3	177.6	12.4	22.6	32.3	39.7	44.3	47.0
11	20.7	38.2	61.3	92.0	123.7	145.5	20.6	38.0	61.3	91.9	123.6	145.3	17.2	30.3	45.3	56.3	63.9	67.0
12	15.1	29.0	41.8	59.5	80.5	97.1	15.1	28.9	41.7	59.4	80.4	96.9	17.3	32.6	47.1	59.0	69.2	73.8
13	31.4	61.5	96.1	135.1	169.6	197.1	31.3	61.4	96.0	134.9	169.4	196.9	11.2	21.3	31.9	41.1	48.7	52.8
14	27.9	50.5	71.8	95.4	127	147.7	27.8	50.5	71.7	95.1	126.6	147.2	19.9	32.9	43.5	51.1	56.3	59.4
15	23.5	46.6	73.8	108.1	144.0	169.5	23.4	46.5	73.7	107.8	143.6	168.9	14.0	29.8	45.1	58.2	72.5	78.2
16	24.2	47.2	73.3	115.7	165.5	204.4	24.1	47.2	73.2	115.5	165.4	204.2	10.4	20.1	29.7	38.1	45.0	47.6
17	31.2	57.6	88.5	125.4	157.1	181.0	31.1	57.5	88.1	124.9	156.5	180.2	10.8	22.2	31.7	38.7	45.8	49.2
18	19.8	41.9	67.3	96.8	127.0	150.5	19.8	41.8	67.2	96.7	126.9	150.4	10.0	19.8	29.8	37.5	43.9	46.1
19	12.2	20.8	26.8	38.5	56.5	77.0	12.2	20.7	26.7	38.4	56.7	77.2	10.3	19.3	29.4	38.7	48.5	50.8
20	29.6	46.4	59.3	75.0	103.5	132.3	29.6	46.4	59.2	74.8	103.2	131.8	15.2	30.5	46.0	58.9	68.7	72.9
Mean	23.4	44.1	67.1	95.6	127.8	151.4	23.4	44.1	67.0	95.4	127.6	152.4	13.8	26.4	39.0	49.4	58.1	62.0

Table D.3.5 Maximum accelerations of 4-storey building (with GWB), (g)

No.	SAPWood							
	E-W				N-S			
	st1	st2	st3	st4	st1	st2	st3	st4
1	0.32	0.31	0.39	0.41	0.34	0.35	0.28	0.35
2	0.28	0.39	0.36	0.38	0.34	0.27	0.29	0.31
3	0.39	0.41	0.43	0.50	0.36	0.43	0.34	0.46
4	0.44	0.39	0.39	0.43	0.32	0.35	0.30	0.39
5	0.30	0.26	0.25	0.28	0.33	0.30	0.25	0.28
6	0.28	0.29	0.28	0.32	0.34	0.34	0.30	0.36
7	0.28	0.34	0.39	0.40	0.19	0.27	0.27	0.27
8	0.31	0.34	0.42	0.46	0.33	0.28	0.28	0.33
9	0.30	0.30	0.26	0.29	0.33	0.29	0.26	0.26
10	0.27	0.24	0.28	0.30	0.28	0.25	0.23	0.26
11	0.28	0.39	0.38	0.50	0.30	0.34	0.31	0.41
12	0.40	0.32	0.39	0.44	0.24	0.37	0.32	0.38
13	0.22	0.24	0.24	0.28	0.35	0.32	0.27	0.35
14	0.37	0.35	0.28	0.40	0.40	0.30	0.25	0.28
15	0.38	0.37	0.39	0.46	0.42	0.43	0.31	0.39
16	0.21	0.25	0.23	0.26	0.29	0.26	0.27	0.31
17	0.23	0.26	0.32	0.37	0.29	0.28	0.29	0.31
18	0.35	0.30	0.31	0.39	0.33	0.30	0.29	0.37
19	0.44	0.40	0.41	0.48	0.42	0.32	0.32	0.33
20	0.44	0.39	0.42	0.50	0.46	0.33	0.31	0.40
Mean	0.32	0.33	0.34	0.39	0.33	0.32	0.29	0.34

Note:
The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

Table D.3.6 Maximum accelerations of 6-storey building (with GWB), (g)

No.	SAPWood											
	E-W						N-S					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.32	0.29	0.38	0.33	0.33	0.38	0.22	0.28	0.22	0.31	0.26	0.32
2	0.30	0.28	0.25	0.28	0.34	0.38	0.27	0.21	0.20	0.24	0.27	0.30
3	0.30	0.35	0.38	0.41	0.39	0.45	0.32	0.35	0.33	0.40	0.37	0.49
4	0.40	0.34	0.33	0.30	0.31	0.35	0.33	0.31	0.25	0.30	0.26	0.34
5	0.24	0.26	0.29	0.25	0.23	0.31	0.30	0.22	0.23	0.28	0.26	0.31
6	0.24	0.29	0.31	0.29	0.27	0.36	0.29	0.25	0.28	0.34	0.30	0.37
7	0.31	0.25	0.30	0.34	0.33	0.40	0.27	0.21	0.23	0.26	0.25	0.26
8	0.32	0.27	0.22	0.26	0.33	0.36	0.37	0.32	0.26	0.29	0.23	0.30
9	0.29	0.24	0.20	0.25	0.28	0.31	0.36	0.26	0.25	0.33	0.28	0.37
10	0.16	0.19	0.19	0.21	0.23	0.24	0.18	0.15	0.17	0.19	0.18	0.22
11	0.23	0.22	0.29	0.28	0.29	0.33	0.23	0.18	0.21	0.29	0.28	0.38
12	0.29	0.28	0.28	0.33	0.31	0.36	0.30	0.27	0.24	0.28	0.27	0.37
13	0.24	0.26	0.30	0.30	0.28	0.36	0.26	0.24	0.28	0.37	0.33	0.40
14	0.41	0.46	0.36	0.28	0.25	0.30	0.35	0.32	0.31	0.29	0.24	0.26
15	0.35	0.38	0.38	0.35	0.38	0.45	0.33	0.34	0.41	0.41	0.32	0.40
16	0.21	0.23	0.22	0.24	0.25	0.27	0.31	0.26	0.33	0.32	0.25	0.29
17	0.24	0.24	0.24	0.22	0.23	0.25	0.30	0.29	0.25	0.32	0.28	0.34
18	0.27	0.28	0.32	0.28	0.26	0.35	0.29	0.25	0.22	0.26	0.24	0.30
19	0.41	0.37	0.26	0.23	0.32	0.35	0.37	0.37	0.29	0.29	0.26	0.37
20	0.52	0.42	0.30	0.33	0.36	0.41	0.44	0.54	0.54	0.33	0.30	0.38
Mean	0.30	0.30	0.29	0.29	0.30	0.35	0.30	0.28	0.28	0.31	0.27	0.34

Note:
The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

D.4 Maximum inter-storey drift

Table D.4.1 Inter-storey drift of 4-storey building in E-W direction (with GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 8				Wall 4				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.23	0.90	0.67	0.31	1.29	0.77	0.69	0.32	0.84	0.51	0.43	0.15
2	1.27	0.87	0.61	0.30	1.43	0.75	0.62	0.30	1.19	0.63	0.41	0.14
3	1.18	0.91	0.51	0.25	1.26	0.78	0.52	0.26	0.67	0.92	0.56	0.23
4	0.66	0.69	0.67	0.32	0.60	0.57	0.71	0.33	0.76	0.85	0.64	0.24
5	0.88	0.52	0.46	0.27	0.93	0.47	0.44	0.26	0.36	0.40	0.32	0.12
6	0.58	0.48	0.41	0.22	0.54	0.44	0.41	0.22	0.40	0.41	0.37	0.15
7	1.49	1.09	0.52	0.27	1.54	0.97	0.52	0.26	1.21	0.62	0.44	0.12
8	0.88	0.99	0.75	0.34	1.04	0.85	0.72	0.34	0.79	0.86	0.63	0.17
9	0.68	0.53	0.45	0.25	0.78	0.46	0.44	0.24	0.40	0.41	0.32	0.12
10	0.80	0.55	0.51	0.30	0.85	0.51	0.49	0.28	0.36	0.37	0.31	0.12
11	1.35	0.80	0.63	0.34	1.40	0.72	0.61	0.29	0.58	0.60	0.56	0.28
12	1.60	0.95	0.63	0.33	1.70	0.89	0.66	0.34	0.64	0.68	0.55	0.31
13	0.57	0.50	0.45	0.24	0.62	0.46	0.47	0.23	0.41	0.34	0.24	0.10
14	0.89	0.46	0.47	0.29	0.93	0.42	0.46	0.27	0.78	0.43	0.44	0.23
15	1.18	0.83	0.57	0.30	1.16	0.64	0.58	0.29	0.61	0.61	0.59	0.20
16	0.70	0.54	0.46	0.24	0.73	0.48	0.47	0.23	0.36	0.36	0.31	0.12
17	0.97	0.54	0.41	0.24	1.00	0.48	0.41	0.25	0.51	0.43	0.37	0.16
18	0.71	0.59	0.54	0.31	0.78	0.55	0.58	0.30	0.41	0.41	0.46	0.21
19	1.07	0.87	0.66	0.31	1.15	0.73	0.67	0.31	0.56	0.71	0.77	0.32
20	1.01	1.05	0.87	0.38	1.09	0.90	0.87	0.37	0.97	0.80	0.67	0.21
Mean	0.98	0.73	0.56	0.29	1.04	0.64	0.57	0.28	0.64	0.57	0.47	0.18

Note:
Storey height = 2750 mm

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Table D.4.2 Inter-storey drift of 4-storey building in N-S direction (with GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 19				Wall 25				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.12	1.03	1.22	0.83	1.12	1.03	1.22	0.83	0.97	0.81	0.79	0.27
2	1.00	0.94	0.96	0.60	1.00	0.94	0.96	0.60	1.20	0.76	0.68	0.18
3	0.90	0.88	0.91	0.65	0.90	0.88	0.91	0.65	0.93	0.89	1.12	0.37
4	1.00	0.83	1.12	0.76	1.00	0.83	1.12	0.76	0.84	0.83	0.92	0.30
5	1.10	0.89	1.04	0.73	1.10	0.89	1.04	0.73	0.63	0.68	0.58	0.24
6	1.16	0.88	0.93	0.68	1.15	0.87	0.93	0.68	0.66	0.72	0.76	0.29
7	1.13	1.15	1.10	0.70	1.13	1.14	1.10	0.70	1.21	0.80	0.52	0.11
8	0.57	0.68	1.01	0.72	0.57	0.68	1.01	0.72	0.60	0.70	0.82	0.24
9	1.10	0.93	0.93	0.59	1.10	0.93	0.93	0.58	0.87	0.65	0.57	0.13
10	1.14	0.92	0.91	0.66	1.14	0.92	0.91	0.66	0.76	0.59	0.55	0.21
11	1.22	1.07	1.01	0.66	1.22	1.07	1.00	0.66	0.92	0.78	0.87	0.31
12	1.57	1.19	1.05	0.77	1.57	1.19	1.05	0.77	0.88	0.76	0.98	0.37
13	0.92	0.63	0.67	0.49	0.92	0.62	0.67	0.49	0.60	0.67	0.63	0.23
14	1.09	0.70	0.65	0.52	1.09	0.70	0.65	0.52	1.12	0.73	0.68	0.29
15	1.00	0.85	0.91	0.62	1.00	0.85	0.91	0.62	0.95	0.86	1.16	0.25
16	0.85	0.67	0.75	0.54	0.85	0.67	0.75	0.54	0.56	0.57	0.59	0.27
17	0.80	0.62	0.69	0.48	0.80	0.62	0.69	0.48	0.61	0.69	0.57	0.27
18	0.99	0.72	0.71	0.60	0.99	0.72	0.71	0.60	0.67	0.64	0.77	0.27
19	0.66	0.74	1.09	0.72	0.66	0.74	1.10	0.72	0.66	0.65	0.83	0.29
20	1.10	0.98	1.12	0.71	1.10	0.98	1.12	0.71	0.95	0.93	0.80	0.29
Mean	1.02	0.86	0.94	0.65	1.02	0.86	0.94	0.65	0.83	0.74	0.76	0.26

Note:
Storey height = 2750 mm

Table D.4.3 Inter-storey drift of 6-storey building in E-W direction (with GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 8						Wall 4						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.75	0.77	0.98	0.91	0.83	0.46	0.68	0.66	1.26	0.87	0.79	0.45	0.52	0.56	0.61	0.52	0.47	0.19
2	0.62	0.62	0.79	0.75	0.65	0.39	0.64	0.60	0.89	0.68	0.64	0.39	0.57	0.61	0.63	0.44	0.32	0.16
3	0.67	0.67	0.75	0.68	0.70	0.43	0.64	0.63	0.95	0.64	0.65	0.42	0.60	0.49	0.62	0.72	0.59	0.22
4	0.75	0.80	1.00	0.93	0.85	0.46	0.74	0.70	1.24	0.88	0.83	0.47	0.51	0.57	0.59	0.52	0.43	0.19
5	0.79	0.78	0.77	0.67	0.57	0.37	0.81	0.64	0.87	0.61	0.54	0.35	0.45	0.43	0.42	0.34	0.32	0.17
6	0.86	0.81	0.75	0.68	0.65	0.41	0.81	0.65	0.79	0.62	0.66	0.41	0.42	0.43	0.43	0.38	0.39	0.20
7	0.65	0.73	0.96	0.84	0.73	0.42	0.63	0.68	1.09	0.72	0.65	0.42	0.64	0.62	0.73	0.47	0.37	0.17
8	0.45	0.54	0.74	0.83	0.84	0.46	0.47	0.55	0.79	0.75	0.82	0.47	0.39	0.44	0.49	0.56	0.37	0.18
9	0.77	0.84	0.94	0.79	0.64	0.39	0.76	0.73	1.19	0.77	0.70	0.44	0.53	0.49	0.47	0.33	0.23	0.13
10	0.68	0.68	0.73	0.66	0.56	0.35	0.73	0.61	0.81	0.59	0.55	0.37	0.45	0.38	0.35	0.27	0.21	0.12
11	0.81	0.88	0.98	0.83	0.67	0.41	0.88	0.79	1.12	0.73	0.68	0.44	0.63	0.60	0.55	0.45	0.31	0.14
12	0.78	0.85	0.89	0.72	0.69	0.43	0.79	0.75	1.08	0.68	0.62	0.39	0.63	0.57	0.54	0.47	0.41	0.20
13	0.61	0.59	0.66	0.58	0.50	0.32	0.54	0.54	0.66	0.52	0.50	0.33	0.41	0.41	0.43	0.38	0.40	0.16
14	0.90	0.68	0.68	0.55	0.49	0.32	0.87	0.63	0.73	0.51	0.50	0.30	0.72	0.56	0.55	0.36	0.32	0.17
15	0.70	0.69	0.76	0.73	0.68	0.42	0.61	0.61	0.86	0.67	0.67	0.43	0.51	0.61	0.61	0.51	0.60	0.21
16	0.62	0.66	0.81	0.74	0.64	0.38	0.60	0.60	0.97	0.69	0.65	0.40	0.38	0.38	0.37	0.32	0.28	0.15
17	0.63	0.58	0.59	0.53	0.47	0.31	0.59	0.53	0.56	0.48	0.46	0.30	0.39	0.42	0.38	0.32	0.27	0.14
18	0.66	0.65	0.70	0.69	0.66	0.41	0.68	0.62	0.82	0.57	0.61	0.38	0.36	0.39	0.41	0.37	0.33	0.16
19	0.43	0.50	0.52	0.62	0.76	0.44	0.44	0.51	0.56	0.61	0.78	0.46	0.37	0.44	0.50	0.43	0.43	0.17
20	0.59	0.71	0.94	0.87	0.73	0.41	0.60	0.67	1.09	0.81	0.74	0.43	0.55	0.59	0.66	0.50	0.45	0.19
Mean	0.69	0.70	0.80	0.73	0.66	0.40	0.68	0.63	0.92	0.67	0.65	0.40	0.50	0.50	0.52	0.43	0.38	0.17

Note:
Storey height = 2750 mm

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Table D.4.4 Inter-storey drift of 6-storey building in N-S direction (with GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 19						Wall 25						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.94	0.85	0.84	0.93	1.06	0.77	0.94	0.85	0.84	0.93	1.05	0.77	0.66	0.55	0.66	0.83	0.60	0.14
2	0.61	0.55	0.64	0.85	1.46	1.02	0.61	0.55	0.64	0.85	1.46	1.01	0.53	0.69	0.61	0.64	0.59	0.14
3	0.97	0.69	0.80	1.18	1.46	0.92	0.97	0.68	0.80	1.18	1.45	0.92	0.90	0.73	0.67	0.75	1.31	0.36
4	0.75	0.75	0.83	1.04	1.45	1.08	0.75	0.75	0.83	1.04	1.45	1.08	0.81	0.63	0.61	0.65	0.77	0.25
5	0.81	0.91	1.27	1.62	1.67	1.25	0.81	0.91	1.27	1.62	1.67	1.25	0.49	0.53	0.46	0.48	0.58	0.20
6	1.02	1.00	1.15	1.26	1.15	0.87	1.02	1.00	1.14	1.26	1.15	0.87	0.56	0.58	0.54	0.64	0.64	0.29
7	0.79	0.68	0.75	0.91	1.16	0.86	0.79	0.68	0.75	0.90	1.16	0.86	0.84	0.73	0.61	0.59	0.41	0.10
8	1.25	2.07	2.74	3.66	4.64	5.47	1.25	2.06	2.73	3.65	4.62	5.45	0.63	0.60	0.58	0.67	0.59	0.21
9	1.13	1.04	1.20	1.37	1.21	0.92	1.13	1.03	1.19	1.36	1.20	0.92	0.85	0.65	0.58	0.56	0.62	0.19
10	0.71	0.76	1.11	1.35	1.68	1.23	0.71	0.76	1.10	1.34	1.68	1.22	0.59	0.47	0.46	0.37	0.32	0.13
11	0.75	0.73	0.93	1.11	1.34	0.98	0.75	0.73	0.93	1.11	1.34	0.98	0.53	0.56	0.58	0.55	0.66	0.22
12	0.55	0.54	0.61	0.70	0.83	0.69	0.55	0.54	0.61	0.70	0.84	0.69	0.65	0.67	0.52	0.55	0.71	0.30
13	1.14	1.11	1.28	1.42	1.27	1.01	1.14	1.11	1.28	1.42	1.27	1.01	0.63	0.65	0.52	0.60	0.80	0.33
14	1.01	0.86	0.93	1.20	1.15	0.89	1.01	0.86	0.93	1.19	1.15	0.89	0.95	0.63	0.58	0.62	0.53	0.23
15	0.85	0.88	1.07	1.41	1.41	1.05	0.85	0.88	1.06	1.41	1.41	1.05	0.79	0.69	0.69	0.70	1.01	0.24
16	0.88	0.84	1.28	1.64	1.86	1.41	0.88	0.84	1.28	1.64	1.86	1.41	0.57	0.57	0.57	0.62	0.59	0.24
17	0.97	0.79	1.14	1.52	1.65	1.25	0.97	1.70	2.63	4.10	5.73	6.97	0.57	0.61	0.56	0.56	0.56	0.28
18	0.72	0.82	0.98	1.18	1.24	0.97	0.72	0.82	0.98	1.18	1.24	0.97	0.45	0.44	0.47	0.46	0.55	0.22
19	0.44	0.38	0.42	0.57	1.02	0.83	0.44	0.38	0.41	0.57	1.02	0.83	0.59	0.53	0.51	0.59	0.70	0.27
20	1.08	0.63	0.69	1.04	1.98	1.28	1.08	0.63	0.69	1.04	1.97	1.27	0.93	0.68	0.76	0.95	0.74	0.30
Mean	0.87	0.84	1.03	1.30	1.53	1.24	0.87	0.89	1.10	1.42	1.74	1.52	0.68	0.61	0.58	0.62	0.66	0.23

Note:
Storey height = 2750 mm

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D.5 Maximum shear wall deformation at each storey

Table D.5.1 Shear wall deformation of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D							
	Wall 8				Wall 4			
	st1	st2	st3	st4	st1	st2	st3	st4
1	32.9	23.2	16.2	6.0	34.1	19.2	16.4	6.0
2	33.8	22.5	14.7	5.9	37.9	18.6	14.3	5.0
3	31.5	23.4	11.8	5.1	33.5	19.4	11.6	5.3
4	17.1	17.4	16.2	6.8	15.2	13.7	17.0	6.1
5	23.5	13.1	10.9	5.7	24.7	11.7	10.0	5.1
6	15.1	12.0	9.4	3.9	14.0	10.2	9.2	3.7
7	40.0	28.5	12.4	5.1	40.8	24.5	11.4	4.0
8	23.1	25.7	18.7	6.8	27.3	21.0	17.1	6.2
9	17.8	13.4	10.4	4.9	20.3	10.9	9.7	4.0
10	21.2	13.7	12.1	6.0	22.4	12.1	11.0	4.8
11	36.1	20.4	15.5	6.9	37.4	18.0	14.0	4.9
12	42.9	24.4	14.9	6.5	45.2	22.5	15.5	6.3
13	15.0	12.5	10.6	4.6	15.9	10.6	10.6	3.8
14	23.5	11.3	11.6	6.7	24.6	10.0	11.1	5.5
15	31.4	21.4	13.3	5.7	30.5	15.6	13.3	5.1
16	18.3	13.3	10.5	4.7	19.0	11.4	10.5	3.9
17	25.8	13.5	9.4	4.6	26.4	11.2	9.1	4.2
18	18.8	14.9	12.9	6.5	20.4	13.0	13.3	5.3
19	28.4	22.6	16.1	6.3	30.2	18.0	15.4	5.4
20	26.9	27.4	21.7	7.8	28.5	22.6	20.8	6.4
Mean	26.2	18.7	13.5	5.8	27.4	15.7	13.1	5.0

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Table D.5.2 Shear wall deformation of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D							
	Wall 19				Wall 25			
	st1	st2	st3	st4	st1	st2	st3	st4
1	24.8	19.1	20.6	8.2	26.0	20.3	22.2	9.9
2	22.7	17.9	14.5	5.0	23.4	19.0	16.0	6.2
3	20.3	16.2	14.5	5.5	21.0	17.3	15.8	6.9
4	24.0	15.4	18.9	8.4	24.4	16.4	20.4	9.7
5	25.7	16.1	17.0	7.8	26.4	17.3	18.4	9.0
6	28.0	16.5	15.2	6.8	28.6	17.6	16.5	8.0
7	24.0	20.9	15.9	4.3	25.9	22.7	18.2	6.4
8	11.5	10.9	15.9	5.5	12.0	12.0	17.4	7.0
9	25.2	17.4	14.8	4.6	25.9	18.5	16.2	5.8
10	25.9	16.0	12.6	5.4	26.7	17.2	14.2	6.3
11	27.0	18.6	13.7	4.0	28.4	20.8	16.1	5.9
12	37.7	24.2	17.7	7.9	38.5	25.3	19.1	9.2
13	21.1	10.4	9.2	4.5	21.6	11.3	10.2	5.0
14	25.8	13.0	10.5	6.9	26.3	13.8	11.5	7.8
15	22.6	15.2	14.0	5.1	23.4	16.4	15.5	6.4
16	19.4	11.5	11.1	4.6	19.9	12.4	12.4	5.7
17	17.5	9.0	8.3	3.3	18.0	9.8	9.3	3.9
18	22.9	12.8	10.0	6.7	23.5	13.7	11.1	7.6
19	13.4	12.8	18.2	7.5	13.9	13.7	19.6	8.3
20	24.0	16.8	18.5	7.9	25.0	18.6	20.4	8.7
Mean	23.2	15.5	14.6	6.0	23.9	16.7	16.0	7.2

Table D.5.3 Shear wall deformation of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D											
	Wall 8						Wall 4					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	19.5	19.1	23.1	20.6	17.6	6.9	17.0	14.6	29.9	18.1	14.9	5.0
2	15.6	14.9	18.8	17.0	14.3	6.7	16.0	13.3	19.8	13.2	12.1	5.4
3	17.0	16.3	16.8	14.4	15.0	7.3	16.1	14.3	21.7	12.0	11.9	5.2
4	19.5	19.3	23.6	20.8	17.7	6.7	18.9	16.0	29.3	18.3	15.8	5.5
5	20.3	18.8	17.4	14.0	10.7	5.0	20.6	14.4	19.4	11.3	9.2	4.0
6	22.3	20.1	17.4	14.8	12.7	5.9	20.6	14.6	17.6	11.7	11.7	4.7
7	16.6	17.9	22.7	19.0	15.2	6.6	15.7	15.1	24.8	13.3	10.6	4.3
8	11.7	12.7	17.2	19.3	19.2	8.0	11.6	11.8	17.1	14.8	16.2	5.6
9	19.6	20.2	22.3	17.2	12.2	5.2	19.0	16.4	28.3	15.5	12.5	4.8
10	17.2	16.5	17.0	14.3	10.8	5.2	18.5	13.9	17.6	11.0	8.9	3.5
11	20.8	21.6	23.7	18.9	13.7	6.3	22.5	18.3	25.6	13.9	11.7	4.6
12	19.8	20.5	20.8	15.6	14.6	7.2	19.9	17.1	25.0	13.3	11.0	4.6
13	15.4	13.8	14.8	12.2	9.3	4.6	13.3	11.9	14.3	9.7	8.5	3.6
14	23.5	16.4	15.8	11.7	10.0	5.8	22.4	14.7	16.7	10.2	9.9	4.5
15	18.2	17.2	17.5	16.0	14.1	6.7	15.2	13.4	18.9	12.1	11.5	4.5
16	15.6	15.7	18.6	16.0	12.4	5.9	14.8	13.2	22.4	13.4	11.5	4.3
17	16.0	13.8	13.3	11.2	9.1	4.4	14.8	11.9	11.9	8.9	7.8	3.3
18	17.1	15.3	16.2	15.3	13.7	6.9	17.1	13.9	18.6	11	11.7	5.1
19	10.8	11.6	11.6	13.6	17.3	7.9	10.9	11.4	12.1	11.5	16.0	6.4
20	14.8	17.0	22.6	20.5	16.5	7.5	14.7	14.7	25.2	16.7	13.9	5.3
Mean	17.6	16.9	18.6	16.1	13.8	6.3	17.0	14.2	20.8	13.1	11.9	4.7

Table D.5.4 Shear wall deformation of 6-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D											
	Wall 19						Wall 25					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	20.2	13.4	9.7	11.2	12.4	3.5	20.8	14.3	10.8	12.5	13.6	4.8
2	13.7	10.0	8.5	9.8	22.6	8.5	14.0	10.4	9.1	11.0	24.2	10.2
3	23.7	12.4	10.5	16.4	23.1	7.5	24.2	13.0	11.5	17.9	24.7	9.0
4	15.7	11.8	9.8	12.5	18.2	6.1	16.2	12.7	10.9	13.9	19.8	7.6
5	17.1	13.2	12.7	17.4	15.4	4.0	17.6	14.2	16.4	21.8	19.6	6.4
6	21.4	14.9	13.9	13.9	10.3	3.3	22.2	16.4	15.9	16.0	11.9	4.4
7	17.2	10.6	9.4	11.2	12.4	3.5	17.8	11.2	10.2	12.4	14.0	4.6
8	30.0	14.8	11.0	16.5	20.4	6.1	30.6	15.7	12.3	17.9	21.9	7.3
9	25.1	16.8	16.6	18.0	12.2	3.9	25.7	18.2	18.5	20.2	14.3	5.8
10	15.5	12.4	14.7	17.3	22.9	8.5	15.9	13.0	16.9	19.6	25.4	11.1
11	16.2	10.4	11.7	13.7	14.8	5.9	16.7	11.3	13.1	15.3	16.8	7.4
12	13.8	10.3	9.3	9.7	10.7	7.3	13.9	10.5	9.9	10.4	11.4	8.1
13	24.2	17.0	14.9	15.5	10.0	2.9	25.1	18.8	18.2	18.9	12.0	4.2
14	23.3	14.7	12.4	17.5	14.4	5.6	23.8	15.6	13.9	19.3	16.2	7.2
15	18.4	13.4	13.5	20.3	18.8	7.5	18.9	14.4	15.3	22.4	20.9	9.5
16	18.9	13.2	12.7	17.7	18.5	5.9	19.4	14.1	15.5	21.0	22.9	8.8
17	22.1	12.7	14.1	20.7	20.1	7.5	22.6	13.6	17.1	23.3	23.2	10.2
18	15.6	11.7	10.7	13.7	11.3	4.6	16.0	12.6	12.1	15.4	13.4	5.5
19	12.0	9.7	5.9	6.9	13.4	7.4	12.1	9.8	6.2	7.5	14.5	8.3
20	26.8	13.5	8.8	15.2	36.7	17.1	27.2	13.8	9.5	16.8	39.0	19.6
Mean	19.5	12.8	11.5	14.8	16.9	6.3	20.0	13.7	13.2	16.7	19.0	8.0

D.6 Maximum uplift forces and deformations

Table D.6.1 Maximum uplift forces of 4-storey building in E-W direction (with GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	39.0	20.8	8.2	0.0	59.8	30.8	9.4	0	47.3	34.2	16.9	8.3	20.2	20.0	16.4	7.5
2	49.3	22.3	8.0	0.2	63.2	32.9	11.3	0.3	54.0	34.1	16.0	9.4	38.8	32.2	17.2	5.8
3	29.4	11.6	7.3	1.1	36.3	14.0	8.3	1.1	64.6	49.5	27.7	11.7	34.3	38.5	22.2	9.1
4	30.6	22.4	12.1	2.2	36.8	27.3	13.5	3.0	63.0	46.5	27.8	13.5	33.5	36.7	23.8	11.0
5	32.3	15.8	7.1	0.3	32.9	16.6	8.7	0.4	42.4	33.8	22.7	15.3	21.9	23.2	14.5	6.4
6	27.9	12.4	0.0	0.0	36.7	17.0	0	0	51.9	36.0	22.1	8.3	24.8	24.4	16.6	7.4
7	42.9	20.9	4.7	0.0	66.4	32.2	6.4	0	32.1	24.8	18.0	8.8	20.9	18.0	6.3	3.4
8	50.7	26.5	10.5	1.9	62.7	39.2	14.6	2.4	57.5	46.1	23.5	14.7	32.9	34.5	21.7	9.5
9	37.3	16.5	3.3	0.0	43.5	22.2	4.0	0	47.6	31.1	14.1	7.2	22.7	24.4	14.2	6.8
10	36.2	18.5	7.3	0.0	37.0	23.2	9.6	0	53.2	33.5	18.1	12.1	22.0	24.3	13.6	6.3
11	51.3	28.1	8.1	0.1	62.2	32.7	11.4	0.1	65.0	42.9	21.2	11.1	33.0	33.4	22.1	12.8
12	46.0	25.0	10.8	1.6	58.1	31.9	12.2	1.9	68.5	43.7	24.2	13.4	33.0	33.7	21.8	13.1
13	32.1	17.2	4.7	0.0	45.2	24.0	5.9	0	45.1	35.3	18.2	7.8	23.6	21.5	11.1	4.8
14	23.2	8.7	9.2	1.1	25.5	8.5	10.7	1.5	53.6	34.9	21.4	10.4	37.8	27.8	16.9	8.7
15	36.5	18.6	7.1	0.0	49.4	25.8	7.9	0	62.4	45.8	22.3	11.1	33.1	33.2	20.9	10.3
16	15.1	36.6	18.3	33.9	20.2	44.0	20.2	44.0	50.3	40.1	24.4	11.7	22.7	21.9	13.6	6.1
17	33.1	15.1	2.8	0.0	48.3	21.1	3.2	0	49.7	37.3	25.5	11.6	28.5	24.9	14.9	8.1
18	36.5	21.1	8.0	0.8	52.6	31.2	11.4	1.1	42.6	30.2	21.1	10.7	25.8	23.4	20.0	9.6
19	40.8	21.8	8.3	0.9	61.7	33.0	12.0	1.3	69.4	58.5	30.0	13.9	32.3	36.1	25.7	13.9
20	46.0	27.8	12.1	2.6	70.6	42.1	17.9	3.8	43.0	38.1	26.4	14.1	36.0	33.9	23.5	9.6
Mean	36.8	20.4	7.9	2.3	48.4	27.5	10.4	5.1	53.2	38.8	22.1	11.3	28.9	28.3	17.9	8.5

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Table D.6.2 Maximum uplift forces of 4-storey building in N-S direction (with GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	115.1	73.8	36.4	11.5	100.1	64.2	33.1	13.0	8.0	7.2	5.2	2.5	34.8	37.6	26.5	13.9
2	111.3	73.8	35.7	12.8	93.9	63.3	32.2	13.0	15.4	11.3	7.9	5.2	40.3	36.3	24.0	9.5
3	91.1	64.7	38.9	14.6	79.7	57.8	34.2	14.7	14.3	11.2	7.8	5.4	39.6	39.2	28.5	16.2
4	92.8	63.7	37.3	13.0	78.1	54.7	32.8	13.0	12.9	9.2	9.0	5.8	38.6	37.7	27.5	14.5
5	105.1	65.0	33.7	9.8	88.9	56.2	29.9	10.0	14.7	12.1	8.8	6.3	33.3	34.1	23.2	11.9
6	115.1	76.6	37.8	11.1	98.2	65.6	34.1	12.5	14.3	11.6	7.7	5.6	32.0	33.5	25.3	14.5
7	115.1	76.2	35.9	11.0	104.1	67.7	34.5	13.7	8.8	7.3	6.6	4.1	21.1	15.2	12.1	4.9
8	101.3	76.3	42.6	14.5	87.7	66.8	37.9	15.2	19.3	17.8	15.0	8.5	33.8	36.9	25.5	13.0
9	108.4	66.3	28.2	6.0	91.4	57.6	26.9	8.3	15.3	11.0	6.0	3.4	36.0	31.6	20.8	7.5
10	112.4	70.9	38.0	11.6	94.9	60.8	34.0	12.8	14.7	11.3	7.2	5.1	32.9	33.1	23.4	10.8
11	115.1	75.6	35.3	9.9	103.6	67.1	33.7	12.6	22.6	15.7	8.6	4.6	38.8	36.9	27.5	14.6
12	111.0	75.1	44.6	16.7	94.2	64.7	40.0	17.3	16.8	11.5	9.1	6.9	38.2	36.5	27.8	17.5
13	84.8	48.6	26.9	7.2	73.8	44.5	25.2	7.9	14.9	11.5	6.3	3.3	33.5	34.3	24.2	12.9
14	73.9	46.3	27.1	18.3	63.7	42.2	25.6	16.6	13.7	12.5	9.1	6.3	40.3	34.0	23.6	15.0
15	113.8	72.4	33.6	7.1	95.7	62.3	30.7	9.3	21.0	15.5	11.0	5.2	41.4	38.2	27.8	12.8
16	83.2	44.6	19.3	6.7	71.8	40.9	18.8	7.5	15.0	10.7	6.2	4.6	30.7	31.7	23.1	12.7
17	96.1	55.9	23.8	4.8	83.7	51.5	23.4	5.5	16.2	11.7	8.1	4.6	34.3	37.2	24.3	12.5
18	92.9	60.2	34.0	17.9	80.9	54.8	30.3	16.4	14.3	11.9	7.6	4.9	32.6	33.7	25.6	13.6
19	94.8	72.3	45.9	16.8	82.8	64.1	40.3	16.8	19.6	16.5	10.9	7.8	31.8	34.3	26.7	14.9
20	115.1	80.8	43.6	17.0	101.7	70.0	39.4	17.9	19.1	16.7	12.8	8.9	38.1	37.7	26.4	14.6
Mean	102.4	67.0	34.9	11.9	88.4	58.8	31.8	12.7	15.5	12.2	8.5	5.5	35.1	34.5	24.7	12.9

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Table D.6.3 Maximum uplift deformation of 4-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 8				Wall 4				Wall 4 - method A				Wall 4 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	1.38	0.74	0.57	0.00	2.12	1.09	0.65	0	1.67	1.21	1.17	0.58	0.72	0.71	1.14	0.52
2	1.75	0.79	0.55	0.02	2.24	1.16	0.78	0.02	1.91	1.21	1.11	0.65	1.37	1.14	1.19	0.40
3	1.04	0.41	0.51	0.08	1.29	0.50	0.58	0.08	2.28	1.75	1.92	0.81	1.21	1.36	1.54	0.63
4	1.09	0.80	0.84	0.15	1.31	0.97	0.94	0.21	2.23	1.64	1.93	0.93	1.18	1.30	1.65	0.76
5	1.15	0.56	0.50	0.02	1.17	0.59	0.61	0.03	1.50	1.20	1.57	1.06	0.78	0.82	1.00	0.45
6	0.99	0.44	0.00	0.00	1.30	0.60	0	0	1.83	1.27	1.53	0.57	0.88	0.86	1.15	0.51
7	1.52	0.74	0.32	0.00	2.36	1.14	0.44	0	1.13	0.88	1.25	0.61	0.74	0.64	0.43	0.24
8	1.80	0.94	0.73	0.13	2.22	1.39	1.02	0.17	2.03	1.63	1.63	1.02	1.16	1.22	1.51	0.66
9	1.32	0.58	0.23	0.00	1.54	0.79	0.28	0	1.68	1.10	0.98	0.50	0.80	0.86	0.99	0.47
10	1.28	0.66	0.51	0.00	1.31	0.82	0.66	0	1.88	1.19	1.26	0.84	0.78	0.86	0.94	0.44
11	1.82	1.00	0.57	0.01	2.21	1.16	0.79	0.01	2.30	1.52	1.47	0.77	1.17	1.18	1.53	0.89
12	1.63	0.89	0.75	0.11	2.06	1.13	0.85	0.13	2.42	1.55	1.68	0.93	1.17	1.19	1.51	0.91
13	1.14	0.61	0.33	0.00	1.60	0.85	0.41	0	1.60	1.25	1.26	0.54	0.83	0.76	0.77	0.33
14	0.06	0.31	0.64	0.08	0.06	0.30	0.74	0.10	1.89	1.24	1.49	0.72	1.34	0.98	1.17	0.61
15	1.29	0.66	0.49	0.00	1.75	0.91	0.55	0	2.21	1.62	1.55	0.77	1.17	1.17	1.45	0.72
16	1.01	0.54	0.17	0.00	1.35	0.65	0.19	0	1.78	1.42	1.69	0.81	0.80	0.78	0.95	0.43
17	1.18	0.54	0.19	0.00	1.71	0.75	0.22	0	1.76	1.32	1.76	0.81	1.01	0.88	1.04	0.56
18	1.29	0.75	0.56	0.05	1.86	1.10	0.79	0.07	1.51	1.07	1.46	0.74	0.91	0.83	1.39	0.67
19	1.45	0.77	0.58	0.06	2.19	1.17	0.83	0.09	2.46	2.07	2.08	0.96	1.14	1.28	1.78	0.96
20	1.63	0.99	0.84	0.18	2.50	1.49	1.24	0.27	1.52	1.35	1.83	0.98	1.27	1.20	1.63	0.67
Mean	1.29	0.69	0.49	0.04	1.71	0.93	0.66	0.11	1.88	1.37	1.53	0.78	1.02	1.00	1.24	0.59

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Table D.6.4 Maximum uplift deformation of 4-storey building in N-S direction (with GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 19				Wall 25				Wall 25 - method A				Wall 25 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	4.67	2.62	2.53	0.80	3.55	2.28	2.30	0.90	0.28	0.25	0.36	0.17	1.23	1.33	1.84	0.97
2	3.94	2.61	2.48	0.89	3.33	2.24	2.24	0.90	0.54	0.40	0.55	0.36	1.43	1.28	1.67	0.66
3	3.23	2.29	2.70	1.02	2.82	2.05	2.38	1.02	0.51	0.40	0.54	0.37	1.40	1.39	1.98	1.12
4	3.29	2.26	2.59	0.90	2.77	1.94	2.28	0.91	0.45	0.33	0.63	0.40	1.36	1.33	1.91	1.01
5	3.73	2.30	2.34	0.68	3.15	1.99	2.08	0.70	0.52	0.43	0.61	0.44	1.18	1.21	1.61	0.82
6	4.25	2.72	2.63	0.77	3.48	2.33	2.37	0.87	0.51	0.41	0.54	0.39	1.13	1.19	1.75	1.01
7	5.54	2.70	2.49	0.76	3.69	2.40	2.40	0.96	0.31	0.26	0.46	0.29	0.75	0.54	0.84	0.34
8	3.59	2.71	2.96	1.01	3.11	2.37	2.63	1.05	0.68	0.63	1.04	0.59	1.20	1.31	1.76	0.90
9	3.84	2.35	1.96	0.42	3.24	2.04	1.87	0.57	0.54	0.39	0.42	0.24	1.27	1.12	1.44	0.52
10	3.99	2.51	2.64	0.81	3.36	2.15	2.36	0.89	0.52	0.40	0.50	0.35	1.16	1.17	1.62	0.75
11	5.32	2.68	2.45	0.69	3.67	2.38	2.34	0.87	0.80	0.56	0.60	0.32	1.37	1.31	1.91	1.01
12	3.94	2.66	3.10	1.16	3.34	2.29	2.78	1.20	0.59	0.41	0.63	0.48	1.35	1.29	1.93	1.21
13	3.01	1.72	1.87	0.50	2.61	1.58	1.75	0.55	0.53	0.41	0.44	0.23	1.19	1.21	1.68	0.89
14	2.62	1.64	1.88	1.27	2.26	1.50	1.78	1.15	0.48	0.44	0.63	0.44	1.43	1.20	1.64	1.04
15	4.04	2.57	2.34	0.49	3.39	2.21	2.14	0.65	0.74	0.55	0.76	0.36	1.46	1.35	1.92	0.89
16	2.95	1.58	1.34	0.47	2.54	1.45	1.30	0.52	0.53	0.38	0.43	0.32	1.09	1.12	1.60	0.88
17	3.41	1.98	1.66	0.33	2.97	1.82	1.62	0.38	0.57	0.41	0.56	0.32	1.21	1.32	1.68	0.87
18	3.29	2.13	2.36	1.24	2.87	1.94	2.11	1.14	0.50	0.42	0.53	0.34	1.15	1.19	1.78	0.95
19	3.36	2.56	3.19	1.17	2.94	2.27	2.80	1.17	0.69	0.58	0.76	0.54	1.12	1.21	1.85	1.03
20	4.68	2.87	3.03	1.18	3.61	2.48	2.74	1.24	0.68	0.59	0.88	0.62	1.35	1.33	1.83	1.02
Mean	3.83	2.37	2.43	0.83	3.14	2.09	2.21	0.88	0.55	0.43	0.59	0.38	1.24	1.22	1.71	0.89

Table D.6.5 Maximum uplift forces of 6-storey building in E-W direction (with GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	76.7	54.2	46.1	21.9	8.5	1.1	133.7	94.0	57.3	29.2	11.1	1.5	102.8	61.9	62.5	33.1	35.7	15.5	37.3	39.7	34.4	32.1	18.6	9.2
2	103.4	59.1	42.5	21.8	9.8	2.1	114.1	87.1	62.8	34.9	14.6	2.9	72.4	48.0	43.3	17.1	16.3	7.8	45.7	47.1	37.3	31.2	17.2	5.7
3	72.5	48.9	40.8	25.0	9.9	1.5	84.2	67.2	49.0	31.2	14.4	2.1	143.6	85.0	78.5	32.7	26.7	9.7	44.8	41.1	35.4	34.0	21.4	8.8
4	78.5	57.2	41.1	24.2	9.4	0.4	104.7	69.4	50.5	30.4	11.6	0.4	95.8	57.8	67.8	31.8	30.0	14.0	38.4	45.6	34.0	31.8	17.7	8.6
5	96.0	59.8	31.9	13.3	4.3	0.0	108.1	71.4	37.7	16.2	4.8	0	81.5	48.8	48.8	23.5	17.5	7.8	33.4	34.8	27.4	22.1	14.9	6.7
6	88.1	56.4	44.0	22.1	8.8	0.0	126.3	91.0	57.4	31.9	10.9	0.0	116.4	70.9	63.9	28.3	24.1	9.8	34.1	34.2	27.7	22.6	16.1	8.4
7	130.2	62.5	44.2	21.8	7.2	0.0	140.4	102.1	64.8	33.8	10.8	0	42.6	24.2	27.6	13.5	13.4	8.5	31.2	31.6	22.3	15.7	8.4	3.7
8	50.3	62.0	46.8	26.0	10.9	2.2	113.3	92.6	68.4	41.1	17.6	3.3	85.4	52.0	59.8	34.6	36.9	15.4	32.1	34.5	26.7	29.7	16.4	7.4
9	109.4	72.4	45.4	23.7	6.5	0.0	125.9	92.5	56.9	30.1	8.4	0	120.3	67.7	64.4	29.6	25.1	9.8	37.4	35.8	27.6	22.3	12.2	5.5
10	106.4	66.8	36.3	21.1	4.9	0.0	121.5	86.5	53.6	28.3	6.8	0	95.4	52.6	48.1	20.9	17.9	8.6	32.9	29.2	21.8	17.3	9.4	5.9
11	122.3	73.3	45.2	22.8	8.7	0.4	137.1	101.0	67.6	36.1	12.8	0.6	97.7	58.4	57.8	25.6	23.8	11.4	40.0	37.8	29.9	25.2	13.5	5.5
12	69.7	52.7	39.0	22.9	8.8	0.3	80.0	64.5	48.5	28.6	12.2	0.4	96.8	61.5	57.8	32.3	33.7	15.0	43.0	44.0	33.2	30.6	19.6	8.0
13	80.1	51.5	35.3	17.8	4.4	0.0	88.3	60.6	40.3	21.4	5.5	0	124.2	70.9	67.6	27.7	22.4	10.1	34.0	32.0	25.9	22.3	17.5	9.2
14	73.8	46.5	29.9	12.3	7.5	0.3	86.1	57.5	35.1	14.4	8.5	0.4	112.2	70.1	69.9	31.8	24.3	13.6	52.5	44.7	33.9	23.4	16.0	7.7
15	90.3	55.3	42.5	21.8	8.1	0.3	134.3	97.1	61.5	34.8	12.5	0.4	107.7	62.1	67.3	30.3	28.8	15.2	44.6	46.3	34.5	26.3	21.5	8.6
16	87.4	56.5	40.9	21.2	8.3	0.0	101.1	74.1	47.7	26.7	10.5	0	78.5	44.2	42.0	21.0	20.1	10.7	30.7	31.3	26.5	20.0	12.0	6.8
17	79.9	40.5	27.1	12.4	1.6	0.0	90.0	54.8	33.5	16.1	1.9	0	97.9	59.5	58.7	24.7	21.8	10.4	31.9	31.3	24.6	21.6	11.9	6.4
18	66.3	63.5	40.8	20.4	12.4	1.5	108.7	80.6	51.3	26.7	14.1	1.9	67.1	38.9	40.7	21.3	18.1	9.0	29.0	31.2	28.8	24.9	16.2	6.8
19	75.0	54.2	49.6	26.0	13.0	3.6	87.1	67.0	58.4	39.8	20.1	5.4	79.7	50.8	52.7	24.8	25.8	16.8	29.8	35.1	33.6	29.7	20.9	7.3
20	97.0	67.1	46.9	24.4	7.8	1.4	132.8	100.8	71.2	39.8	14.4	2.3	75.7	44.0	52.2	23.1	24.2	13.4	37.9	39.7	34.2	28.8	21.7	9.5
Mean	87.7	58.0	40.8	21.1	8.0	0.7	110.9	80.6	53.7	29.6	11.2	1.7	94.7	56.5	56.6	26.4	24.3	11.6	37.0	37.4	30.0	25.6	16.2	7.3

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Table D.6.6 Maximum uplift forces of 6-storey building in N-S direction (with GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	201.1	128.1	76.0	50.8	25.3	5.3	178.6	118.8	73.1	49.1	25.6	7.0	18.7	18.8	13.9	13.9	8.3	5.2	35.3	41.1	48.8	41.6	25.8	8.8
2	120.6	103.0	86.1	69.9	36.8	11.8	110.0	94.5	79.8	63.9	33.6	12.3	37.0	34.7	21.3	16.9	7.3	4.1	52.0	54.1	50.8	40.5	25.1	9.6
3	125.0	87.8	75.9	61.1	34.7	6.3	108.6	82.0	71.0	56.6	31.7	8.2	32.0	27.8	16.4	15.4	7.1	3.1	61.6	56.0	49.3	39.9	31.2	18.1
4	183.7	130.4	108.3	81.6	47.2	17.9	163.3	121.0	100.5	74.7	41.4	18.2	29.1	23.9	14.1	14.5	9.5	4.6	52.3	51.6	47.5	38.5	27.7	14.4
5	246.5	190.2	115.2	82.8	37.7	7.3	220.1	175.7	115.1	79.8	41.3	15.5	26.6	25.8	15.4	12.6	6.6	2.9	40.2	46.3	39.5	30.8	23.6	11.5
6	252.4	182.6	115.1	63.9	23.8	2.1	218.8	160.3	105.0	60.3	27.3	6.4	28.3	24.9	13.5	12.1	6.5	3.4	50.9	46.4	42.2	35.9	26.1	16.1
7	190.3	126.1	74.9	49.4	26.2	8.3	177.4	119	72.4	48.3	26.3	9.6	18.1	17.9	11.0	9.2	4.4	3.0	37.4	33.8	27.1	19.7	13.3	4.8
8	162.1	115.3	85.3	72.2	40.1	10.8	142.7	104.4	80.6	66.8	36.1	11.9	29.7	31.6	20.6	19.4	10.2	5.3	48.0	44.9	39.6	34.9	26.2	12.3
9	224.5	148.0	79.1	40.5	15.8	0.3	197.2	134.5	77.7	41.2	17.1	2.7	27.1	21.9	12.9	11.7	7.0	3.9	54.9	53.9	41.3	33.6	25.7	13.1
10	203.4	156.5	115.1	80.0	45.3	16.9	182.9	142.7	108.5	72.1	42.3	18.9	24.8	22.3	14.2	12.8	7.7	3.7	44.3	41.6	35.3	25.1	16.8	7.9
11	174.5	134.5	108.0	80.3	39.9	9.5	156.7	123.5	98.7	70.8	37.3	12.4	37.1	33.5	20.7	21.1	11.3	4.8	49.0	47.7	41.1	33.4	26.0	13.6
12	111.1	72.4	61.6	49.8	34.6	15.0	97.8	66.0	57.2	46.6	31.5	13.5	20.1	20.1	14.6	19.1	9.9	5.1	53.6	52.6	44.9	35.9	26.3	16.8
13	268.3	190.3	115.1	65.3	24.2	0.3	232.3	175.1	115.1	67.5	30.6	8.5	33.3	29.9	18.0	15.1	6.1	2.8	52.3	53.0	45.8	36.2	27.4	16.7
14	164.5	121.2	82.8	61.3	40.6	16.0	148.2	112.6	76.4	57.3	37.2	17.0	27.6	26.1	17.4	17.1	6.5	5.1	66.0	55.5	47.8	38.0	24.1	13.3
15	185.0	123	78.4	44.6	19.3	2.1	164.3	114.4	75.4	44.2	19.6	4.1	28.5	28.2	18.2	17.2	9.0	6.4	56.3	51.3	50.7	40.1	29.1	14.8
16	236.3	180.9	115.2	90.8	46.1	14.5	214.0	171.4	115.1	86.9	48.7	21.9	25.2	22.1	13.4	14.9	9.1	4.1	48.1	46.5	45.2	37.4	24.5	14.1
17	224.4	169.9	115.1	84.4	43.2	14.7	202.6	158.5	115.1	75.7	42.9	19.3	35.5	32.1	18.3	15.1	6.9	4.0	51.3	50.9	44.2	36.2	24.5	14.9
18	212.0	159.5	113.8	74.6	36.2	10.4	189.3	147.4	105.8	66.4	34.5	11.3	30.3	26.5	15.7	14.2	7.2	3.9	37.0	38.0	36.8	28.7	24.0	11.7
19	49.9	62.3	67.3	62.2	46.6	19.1	44.6	57.9	61.8	56.1	41.2	18.9	20.4	18.7	12.6	12.5	9.4	6.5	50.6	48.3	42.1	37.7	27.3	15.8
20	104.9	103.3	102.1	95.1	58.7	28.2	90.9	95.5	92.2	79.3	49.5	23.8	25.7	27.9	16.8	16.2	7.9	4.8	59.8	51.9	48.7	41.5	28.1	17.3
Mean	182.0	134.9	94.5	68.0	36.1	10.8	162.0	124.0	89.8	63.2	34.8	13.1	27.8	25.7	15.9	15.1	7.9	4.3	50.0	48.3	43.4	35.3	25.1	13.3

Table D.6.7 Maximum uplift deformation of 6-storey building in E-W direction (with GWB), (mm)

No.	Drain-3D												SAPWood											
	Wall 8						Wall 4						Wall 4 - method A						Wall 4 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	1.65	1.92	1.64	1.52	0.59	0.08	2.87	3.33	2.03	2.03	0.77	0.10	2.20	2.19	2.21	2.29	2.47	1.07	0.80	1.41	1.22	2.22	1.29	0.64
2	2.22	2.10	1.51	1.52	0.68	0.15	2.45	3.09	2.23	2.43	1.02	0.20	1.55	1.70	1.53	1.18	1.13	0.54	0.98	1.66	1.32	2.16	1.19	0.40
3	1.56	1.73	1.45	1.74	0.69	0.10	1.81	2.38	1.74	2.17	1.00	0.14	3.07	3.00	2.78	2.27	1.85	0.67	0.96	1.45	1.25	2.35	1.48	0.61
4	1.68	2.03	1.46	1.68	0.65	0.03	2.25	2.46	1.79	2.11	0.81	0.03	2.05	2.04	2.40	2.20	2.08	0.97	0.82	1.61	1.20	2.20	1.22	0.60
5	2.06	2.12	1.13	0.93	0.30	0.00	2.32	2.53	1.34	1.12	0.33	0	1.74	1.72	1.73	1.63	1.21	0.54	0.71	1.23	0.97	1.53	1.04	0.47
6	1.89	2.00	1.56	1.54	0.61	0.00	2.71	3.23	2.03	2.21	0.76	0.00	2.49	2.51	2.26	1.96	1.67	0.68	0.73	1.21	0.98	1.56	1.12	0.59
7	2.79	2.22	1.57	1.52	0.50	0.00	3.01	3.62	2.30	2.35	0.75	0	0.91	0.86	0.98	0.94	0.93	0.59	0.67	1.12	0.79	1.09	0.59	0.26
8	1.08	2.20	1.66	1.80	0.76	0.15	2.43	3.28	2.42	2.86	1.22	0.23	1.83	1.84	2.11	2.40	2.56	1.07	0.69	1.22	0.94	2.06	1.14	0.51
9	2.35	2.57	1.61	1.64	0.45	0.00	2.70	3.28	2.02	2.09	0.58	0	2.57	2.40	2.28	2.05	1.74	0.68	0.80	1.26	0.98	1.55	0.85	0.38
10	2.28	2.37	1.29	1.47	0.34	0.00	2.60	3.07	1.90	1.96	0.47	0	2.04	1.86	1.70	1.45	1.24	0.59	0.70	1.03	0.77	1.20	0.65	0.41
11	2.62	2.60	1.60	1.59	0.60	0.03	2.94	3.58	2.40	2.51	0.89	0.04	2.09	2.06	2.04	1.78	1.65	0.79	0.85	1.34	1.06	1.75	0.94	0.38
12	1.50	1.87	1.38	1.59	0.61	0.02	1.72	2.29	1.72	1.99	0.85	0.03	2.07	2.18	2.05	2.24	2.34	1.04	0.92	1.56	1.18	2.12	1.36	0.55
13	1.72	1.83	1.25	1.24	0.31	0.00	1.89	2.15	1.43	1.49	0.38	0	2.66	2.51	2.39	1.92	1.55	0.70	0.73	1.13	0.92	1.55	1.21	0.63
14	1.58	1.65	1.06	0.85	0.52	0.02	1.85	2.04	1.24	1.00	0.59	0.03	2.40	2.48	2.47	2.20	1.69	0.94	1.12	1.58	1.20	1.62	1.11	0.53
15	1.94	1.96	1.51	1.52	0.56	0.02	2.88	3.44	2.18	2.42	0.87	0.03	2.30	2.20	2.38	2.10	1.99	1.05	0.95	1.64	1.22	1.83	1.49	0.60
16	1.87	2.00	1.45	1.47	0.58	0.00	2.17	2.63	1.69	1.85	0.73	0	1.68	1.56	1.49	1.45	1.39	0.74	0.66	1.11	0.94	1.39	0.83	0.47
17	1.71	1.44	0.96	0.86	0.11	0.00	1.93	1.94	1.19	1.12	0.13	0	2.09	2.10	2.08	1.71	1.51	0.72	0.68	1.11	0.87	1.50	0.82	0.44
18	1.42	2.25	1.45	1.42	0.86	0.10	2.33	2.86	1.82	1.85	0.98	0.13	1.44	1.38	1.44	1.48	1.25	0.62	0.62	1.10	1.02	1.73	1.12	0.47
19	1.61	1.92	1.76	1.81	0.90	0.25	1.87	2.37	2.07	2.77	1.39	0.38	1.71	1.79	1.86	1.72	1.79	1.17	0.64	1.24	1.19	2.06	1.45	0.51
20	2.08	2.38	1.66	1.69	0.54	0.10	2.85	3.57	2.52	2.76	1.00	0.16	1.62	1.56	1.85	1.60	1.68	0.93	0.81	1.40	1.21	2.00	1.50	0.66
Mean	1.88	2.06	1.45	1.47	0.56	0.05	2.38	2.86	1.90	2.05	0.78	0.11	2.03	2.00	2.00	1.83	1.69	0.81	0.79	1.32	1.06	1.77	1.12	0.51

Table D.6.8 Maximum uplift deformation of 6-storey building in N-S direction (with GWB), mm

No.	Drain-3D												SAPWood											
	Wall 19						Wall 25						Wall 25 - method A						Wall 25 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	4.31	2.75	2.70	1.80	1.76	0.37	3.83	2.55	2.59	1.74	1.78	0.49	0.40	0.40	0.49	0.49	0.58	0.36	0.75	0.88	1.72	1.47	1.79	0.61
2	2.59	2.21	3.05	2.48	2.56	0.82	2.36	2.03	2.83	2.27	2.33	0.86	0.79	0.74	0.75	0.60	0.51	0.28	1.11	1.16	1.80	1.43	1.74	0.67
3	2.68	1.88	2.69	2.16	2.41	0.44	2.33	1.76	2.52	2.00	2.20	0.57	0.68	0.59	0.58	0.54	0.49	0.21	1.32	1.20	1.74	1.41	2.16	1.25
4	3.94	2.80	3.84	2.89	3.28	1.24	3.50	2.60	3.56	2.65	2.87	1.27	0.62	0.51	0.50	0.51	0.66	0.32	1.12	1.10	1.68	1.36	1.92	1.00
5	5.29	4.27	11.00	2.93	2.62	0.50	4.72	3.77	7.27	2.83	2.87	1.08	0.57	0.55	0.55	0.45	0.46	0.20	0.86	0.99	1.40	1.09	1.64	0.80
6	5.42	3.92	4.11	2.27	1.65	0.15	4.69	3.44	3.72	2.14	1.90	0.44	0.61	0.53	0.48	0.43	0.45	0.24	1.09	0.99	1.49	1.27	1.81	1.12
7	4.70	2.70	2.66	3.44	1.82	0.58	3.80	2.55	2.57	3.35	1.83	0.66	0.39	0.38	0.39	0.32	0.30	0.21	0.80	0.72	0.96	0.70	0.92	0.33
8	3.48	2.47	3.02	2.56	2.78	0.75	3.06	2.24	2.86	2.37	2.51	0.83	0.64	0.68	0.73	0.68	0.71	0.37	1.03	0.96	1.40	1.23	1.81	0.85
9	4.82	3.17	2.80	1.44	1.10	0.02	4.23	2.88	2.76	1.46	1.19	0.19	0.58	0.47	0.46	0.42	0.48	0.27	1.18	1.15	1.46	1.19	1.78	0.91
10	4.36	3.36	4.48	2.84	3.15	1.17	3.93	3.06	3.84	2.56	2.94	1.31	0.53	0.48	0.50	0.45	0.53	0.26	0.95	0.89	1.25	0.89	1.17	0.55
11	3.74	2.88	3.83	2.85	2.77	0.66	3.36	2.65	3.50	2.51	2.59	0.86	0.79	0.72	0.73	0.75	0.78	0.33	1.05	1.02	1.46	1.18	1.81	0.94
12	2.38	1.55	2.18	1.77	2.41	1.04	2.10	1.42	2.03	1.65	2.19	0.94	0.43	0.43	0.52	0.68	0.69	0.35	1.15	1.13	1.59	1.27	1.83	1.16
13	5.76	4.66	6.40	2.32	1.69	0.02	4.98	3.76	4.35	2.39	2.13	0.59	0.71	0.64	0.64	0.54	0.42	0.19	1.12	1.13	1.62	1.28	1.90	1.16
14	3.53	2.60	2.93	2.17	2.82	1.11	3.18	2.42	2.71	2.03	2.58	1.18	0.59	0.56	0.62	0.61	0.45	0.35	1.41	1.19	1.69	1.34	1.67	0.92
15	3.97	2.64	2.78	1.58	1.34	0.14	3.53	2.45	2.67	1.57	1.36	0.28	0.61	0.60	0.64	0.61	0.62	0.44	1.21	1.10	1.79	1.42	2.02	1.02
16	5.07	3.88	13.35	3.22	3.20	1.01	4.59	3.68	9.17	3.08	3.39	1.52	0.54	0.47	0.47	0.53	0.63	0.28	1.03	0.99	1.60	1.32	1.70	0.98
17	4.82	3.64	7.29	2.99	3.00	1.02	4.35	3.40	5.19	2.68	2.98	1.34	0.76	0.69	0.65	0.53	0.48	0.28	1.10	1.09	1.56	1.28	1.70	1.03
18	4.55	3.42	4.03	2.64	2.52	0.72	4.06	3.16	3.75	2.36	2.40	0.78	0.65	0.57	0.56	0.50	0.50	0.27	0.79	0.81	1.30	1.02	1.67	0.81
19	1.07	1.34	2.38	2.21	3.24	1.33	0.96	1.24	2.19	1.99	2.86	1.31	0.44	0.40	0.44	0.44	0.65	0.45	1.08	1.03	1.49	1.33	1.89	1.10
20	1.97	2.21	3.62	3.17	3.43	1.53	1.83	2.05	0.00	2.77	3.12	1.44	0.55	0.60	0.59	0.57	0.55	0.33	1.28	1.11	1.72	1.47	1.95	1.20
Mean	3.92	2.92	4.46	2.49	2.48	0.73	3.47	2.65	3.50	2.32	2.40	0.90	0.59	0.55	0.56	0.53	0.55	0.30	1.07	1.03	1.54	1.25	1.74	0.92

Appendix E

Results of NEESWood Capstone Wood-Frame Building Designed in Accordance with 2010 NBCC

E.1 Fundamental period of the Building

	4-storey building (s)		6-storey building (s)	
	E-W	N-S	E-W	N-S
Drain-3D	0.59	0.78	0.87	0.94
SAPWood	0.69		1.04	

E.2 Maximum base shear

No.	4-storey building (kN)				6-storey building (kN)			
	Drain-3D		SAPWood		Drain-3D		SAPWood	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
1	446.0	265.0	313.6	242.6	487.0	488.0	284.8	213.0
2	421.0	262.0	381.7	237.6	393.0	421.0	203.6	179.4
3	435.0	275.0	247.5	282.0	438.0	492.0	380.8	223.2
4	386.0	296.0	272.1	254.7	442.0	497.0	311.6	227.1
5	395.0	266.0	165.7	206.7	481.0	511.0	331.4	298.8
6	361.0	271.0	179.1	217.2	493.0	493.0	270.7	236.0
7	483.0	283.0	226.5	142.9	390.0	444.0	358.6	176.2
8	354.0	257.0	181.6	210.2	531.0	532.0	289.9	215.7
9	411.0	270.0	151.3	161.6	502.0	528.0	265.0	222.0
10	435.0	268.0	156.6	207.6	492.0	516.0	255.7	134.9
11	478.0	282.0	202.0	187.1	395.0	372.0	195.0	173.1
12	465.0	269.0	299.8	247.2	395.0	428.0	319.7	260.2
13	318.0	271.0	138.4	219.7	494.0	428.0	241.5	288.0
14	513.0	297.0	312.7	323.9	510.0	559.0	366.6	400.8
15	387.0	270.0	266.6	263.9	497.0	536.0	256.0	256.7
16	366.0	306.0	106.9	169.0	495.0	509.0	283.6	225.4
17	431.0	265.0	130.8	226.7	488.0	518.0	271.3	210.8
18	369.0	281.0	237.0	237.5	446.0	441.0	310.8	266.2
19	547.0	270.0	295.9	287.3	365.0	408.0	354.2	325.7
20	521.0	293.0	323.6	265.8	463.0	474.0	357.3	299.4
Mean	426.1	275.9	229.5	229.6	459.9	479.8	295.4	241.6

E.3 Maximum displacement and acceleration at each storey

Table E.3.1 Maximum displacements of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 1				Wall 5				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	14.0	30.5	60.2	110.0	13.9	30.5	60.5	110.0	23.2	43.3	61.3	86.3
2	12.8	27.3	54.2	126.9	12.6	27.0	53.9	126.3	25.1	44.0	65.0	110.9
3	12.4	24.9	48.5	104.1	12.3	24.7	48.3	103.0	19.0	37.3	55.7	86.6
4	10.5	23.1	45.8	87.5	10.7	23.8	47.2	90.1	18.6	35.7	53.8	81.6
5	11.7	25.4	48.6	96.6	11.5	25.0	47.8	97.9	14.3	23.7	37.2	49.4
6	11.0	23.9	43.7	74.9	11.0	23.7	42.8	73.2	15.4	26.9	36.8	51.3
7	17.4	36.7	71.4	136.0	17.3	36.8	72.2	137.6	22.4	45.2	72.5	111.5
8	11.9	25.8	45.8	104.0	11.5	25.0	44.6	101.9	13.4	27.2	45.0	74.1
9	11.8	25.4	47.2	84.5	12.0	25.9	48.1	85.7	14.2	27.7	45.9	72.6
10	13.1	28.6	54.9	99.4	12.9	28.1	53.3	98.6	16.1	27.7	38.4	51.5
11	15.7	33.4	66.6	126.6	15.2	32.3	65.4	129.9	19.9	40.0	59.0	81.1
12	13.2	26.9	57.4	126.2	12.4	26.5	57.4	127.7	25.1	45.5	64.6	86.2
13	8.4	18.7	35.0	63.2	8.4	18.3	34.7	63.9	13.9	25.3	36.6	50.8
14	13.3	26.9	46.1	94.1	13.6	27.3	47.2	94.6	19.7	33.1	44.8	54.6
15	11.7	25.8	49.8	103.9	11.8	25.9	49.1	104.3	18.0	31.8	47.7	72.5
16	10.7	24.0	46.4	86.9	10.9	24.3	47.5	89.5	12.0	22.0	33.7	49.4
17	13.8	29.7	56.1	101.6	13.7	29.5	56.7	105.0	13.6	23.1	36.3	50.9
18	10.0	20.9	40.3	79.0	10.1	21.6	41.7	79.0	13.2	23.4	37.8	58.8
19	14.6	27.2	46.2	105.2	18.6	27.1	44.9	105.4	14.7	28.8	40.8	67.2
20	15.9	30.7	50.4	95.0	16.7	32.4	55.7	94.2	20.7	37.4	55.3	87.5
Mean	12.7	26.8	50.7	100.3	12.9	26.8	51.0	100.9	17.6	32.4	48.4	71.7

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Table E.3.2 Maximum displacements of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D								SAPWood			
	Wall 6				Wall 8				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	19.9	32.9	85.6	101.2	19.9	32.9	85.6	101.2	25.4	45.5	60.2	76.5
2	20.2	37.3	82.4	96.1	20.2	37.3	82.5	96.1	28.1	48.1	63.9	78.8
3	22.9	35.7	84.9	96.7	22.9	35.7	84.9	96.7	24.4	46.2	62.5	91.9
4	35.5	49.8	74.1	84.7	35.5	49.8	74.1	84.7	22.5	41.9	57.2	80.9
5	20.9	32.8	80.7	96.9	20.9	32.8	80.7	96.9	16.4	29.9	41.7	49.4
6	23.2	35.2	75.3	89.4	23.2	35.2	75.3	89.4	18.2	32.1	45.4	63.0
7	28.4	42.4	85.6	98.2	28.4	42.4	85.6	98.2	35.5	59.7	78.3	92.5
8	13.2	25.5	67.8	82.4	13.2	25.5	67.8	82.4	15.8	31.9	49.4	63.4
9	23.1	38.8	85.3	100.5	23.1	38.8	85.3	100.5	22.5	39.4	51.8	66.0
10	23.2	43.2	78.3	91.7	23.2	43.2	78.3	91.7	21.4	35.8	44.6	53.3
11	28.3	43.2	89.3	106.0	28.3	43.2	89.3	106.0	26.5	45.5	57.2	78.7
12	20.2	44.7	82.3	97.7	20.2	44.7	82.3	97.7	25.5	45.5	63.8	85.8
13	24.0	37.0	63.8	75.1	24.0	37.0	63.8	75.1	14.3	27.4	38.8	56.1
14	33.7	47.4	71.4	83.2	33.7	47.4	71.4	83.2	25.9	38.8	48.2	57.6
15	24.4	41.2	79.0	91.5	24.4	41.2	79.0	91.5	22.7	42.6	59.8	75.2
16	37.8	52.6	72.9	83.2	37.8	52.6	72.9	83.2	15.0	26.1	36.7	48.7
17	20.6	32.2	53.0	62.1	20.6	32.2	53.0	62.1	17.5	33.0	43.7	54.8
18	25.0	37.7	62.1	76.0	25.0	37.7	62.1	76.0	15.8	30.1	44.8	56.3
19	16.4	22.7	56.2	66.6	16.4	22.7	56.2	66.6	17.7	32.7	42.4	53.7
20	32.0	42.3	92.0	106.2	32.0	42.3	92.0	106.2	22.7	42.2	60.9	79.9
Mean	24.6	38.7	76.1	89.3	24.6	38.7	76.1	89.3	21.7	38.7	52.6	68.1

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Table E.3.3 Maximum displacements of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 1						Wall 5						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	17.8	37.2	59.2	84.2	109.5	141.7	18.4	38.5	60.6	84.9	107.3	137.0	16.0	29.4	45.5	63.3	80.8	99.6
2	22.9	47.9	79.6	116.6	155.5	202.1	20.1	43.9	74.5	110.4	148.7	194.3	16.5	28.3	38.5	51.4	71.3	96.0
3	11.7	26.5	44.1	67.1	93.1	132.0	11.2	25.4	42.4	65.0	90.9	130.2	15.3	28.7	43.8	58.9	79.1	116.9
4	13.3	28.9	48.6	76.8	110.8	149.6	12.7	27.2	45.4	72.5	104.9	142.3	16.5	30.8	45.1	58.1	70.2	91.3
5	13.7	30.1	49.6	72.1	95.4	126.1	13.7	31.1	51.0	74.6	98.8	131.7	11.2	20.9	32.1	44.8	55.5	68.8
6	23.9	51.2	83.7	119.9	154.7	193.6	23.3	50.6	83.8	120.6	155.7	195.0	14.2	26.7	38.9	49.7	61.8	77.4
7	19.7	44.9	74.2	106.5	137.6	174.0	21.5	41.7	68.9	99.1	128.1	163.0	11.7	26.2	44.4	66.3	88.8	116.1
8	20.7	47.2	78.9	115.8	151.7	194.3	22.8	49.0	81.8	120.6	160.9	206.2	17.9	27.6	36.1	48.8	61.4	76.8
9	14.5	32.6	53.8	77.4	100.0	126.6	14.5	32.7	54.0	77.9	100.8	127.5	17.5	32.0	48.3	62.6	77.0	96.7
10	17.7	41.2	68.5	99.1	130.0	166.0	19.6	42.7	70.7	102.7	135.4	175.0	12.8	23.9	35.1	45.9	54.6	65.7
11	27.1	43.0	58.5	82.8	109.1	148.1	27.2	43.6	59.2	83.7	110.7	150.9	11.5	24.6	42.5	63.2	81.4	100.5
12	24.1	46.1	76.5	111.3	146.1	187.5	22.6	44.6	74.3	109.1	143.7	184.7	12.1	23.8	35.1	46.8	54.4	65.1
13	15.6	36.6	61.9	92.2	122.3	158.8	15.0	35.3	59.6	88.9	117.8	152.9	13.9	25.7	38.8	54.9	70.5	89.3
14	9.3	18.3	25.4	34.6	45.6	78.6	8.7	17.3	23.9	32.4	42.5	74.9	19.7	31.8	45.1	59.9	71.7	84.5
15	23.4	50.6	80.3	112.3	143.6	178.9	22.8	49.8	78.9	110.1	140.4	177.5	17.7	31.4	46.1	62.1	78.3	100.6
16	14.8	29.7	47.0	68.8	92.2	134.1	14.9	29.7	46.8	67.8	90.4	132.3	12.2	22.4	32.4	41.8	50.0	60.9
17	13.2	31.9	55.5	86.3	120.8	159.6	13.0	31.3	54.5	84.9	118.9	157.3	12.9	23.8	39.7	55.7	68.8	85.2
18	10.9	24.6	40.1	60.0	82.3	117.4	10.4	22.8	37.3	56.0	77.5	109.5	10.1	18.2	26.2	36.7	44.8	54.1
19	21.2	46.5	80.1	118.4	156.8	198.9	21.7	46.7	78.9	115.8	152.5	192.6	10.9	16.3	24.3	34.5	41.4	55.8
20	18.8	39.0	64.4	94.1	124.0	156.1	18.3	37.6	60.8	90.1	120.1	151.5	15.1	25.5	37.8	52.0	69.8	92.6
Mean	17.7	37.7	61.5	89.8	119.1	156.2	17.6	37.1	60.4	88.3	117.3	154.3	14.3	25.9	38.8	52.9	66.6	84.7

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Table E.3.4 Maximum displacements of 6-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D												SAPWood					
	Wall 6						Wall 8						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	15.5	31.3	63.6	85.0	106.7	141.0	15.5	31.3	63.6	85.0	106.7	141.0	23.0	36.7	52.2	66.3	84.2	102.1
2	24.0	42.3	92.9	121.9	154.0	190.0	24.0	42.3	92.9	121.9	154.1	190.0	15.3	27.2	44.4	62.0	73.3	83.9
3	10.2	21.0	40.5	59.6	84.5	122.1	10.2	21.0	40.5	59.6	84.5	122.1	25.3	44.4	69.0	85.6	109.3	141.2
4	13.7	27.7	51.9	74.8	104.3	140.3	13.7	27.7	51.9	74.8	104.3	140.3	22.7	38.6	55.9	70.0	87.8	107.7
5	13.3	28.3	55.5	77.8	101.8	129.9	13.3	28.3	55.5	77.8	101.8	129.9	18.8	32.5	45.7	55.4	65.4	71.5
6	20.1	40.6	88.7	120.1	156.7	192.7	20.1	40.6	88.7	120.1	156.7	192.7	17.7	33.7	46.3	57.8	70.8	78.0
7	15.5	30.8	62.2	83.6	105.8	131.3	15.5	30.8	62.2	83.6	105.8	131.3	19.4	36.2	57.6	71.3	80.4	93.6
8	16.2	32.6	68.3	94.2	122.1	150.9	16.3	32.6	68.3	94.2	122.1	150.9	18.1	34.8	50.5	60.2	63.2	71.8
9	12.1	26.6	50.4	73.5	103.2	140.7	12.1	26.6	50.4	73.5	103.2	140.7	26.6	42.0	66.7	80.5	90.1	99.0
10	18.0	33.6	69.2	91.9	114.7	139.3	18.0	33.6	69.2	91.9	114.7	139.3	12.9	23.6	36.2	49.1	59.2	66.4
11	21.5	36.3	60.2	82.4	108.2	133.7	21.5	36.3	60.2	82.4	108.2	133.7	18.7	34.6	50.4	65.9	82.2	95.7
12	22.1	39.8	81.2	106.7	132.8	162.3	22.1	39.8	81.2	106.7	132.8	162.3	16.9	32.2	46.4	55.6	67.4	79.4
13	12.6	27.8	56.3	80.6	109.0	164.9	12.6	27.8	56.3	80.6	109.0	164.9	22.5	39.3	58.5	73.2	86.0	100.8
14	8.4	17.2	29.2	43.7	63.0	73.8	8.4	17.2	29.2	43.7	63.0	73.8	23.0	38.3	56.3	67.7	75.7	82.7
15	18.6	34.8	72.7	98.4	132.5	166.5	18.6	34.8	72.7	98.4	132.5	166.5	23.5	44.2	62.0	78.7	94.0	105.2
16	12.8	27.2	51.8	74.7	97.5	116.0	12.8	27.2	51.8	74.7	97.5	116.0	17.3	33.4	44.8	55.4	65.1	69.4
17	10.8	24.8	56.2	84.3	120.6	157.8	10.8	24.8	56.2	84.3	120.6	157.8	18.2	32.4	47.2	60.4	67.5	72.0
18	10.3	21.7	39.5	55.4	72.5	107.0	10.3	21.7	39.5	55.4	72.5	107.0	12.1	22.6	30.3	38.9	45.8	57.8
19	21.3	40.1	84.2	113.0	142.3	173.5	21.3	40.1	84.2	113.0	142.3	173.5	15.5	25.1	33.3	37.0	43.7	55.9
20	20.2	35.0	62.2	84.7	109.0	133.6	20.2	35.0	62.2	84.7	109.0	133.6	25.7	42.7	50.4	55.0	67.2	86.3
Mean	15.9	31.0	61.8	85.3	112.1	143.4	15.9	31.0	61.8	85.3	112.1	143.4	19.7	34.7	50.2	62.3	73.9	86.0

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Table E.3.5 Maximum accelerations of 4-storey building (without GWB), (g)

No.	SAPWood							
	E-W				N-S			
	st1	st2	st3	st4	st1	st2	st3	st4
1	0.516	0.352	0.501	0.560	0.348	0.462	0.409	0.462
2	0.378	0.295	0.386	0.643	0.319	0.298	0.380	0.428
3	0.440	0.359	0.356	0.619	0.323	0.377	0.431	0.528
4	0.319	0.381	0.505	0.601	0.362	0.385	0.369	0.429
5	0.224	0.269	0.290	0.385	0.310	0.345	0.312	0.370
6	0.310	0.271	0.354	0.436	0.324	0.386	0.353	0.401
7	0.309	0.333	0.465	0.598	0.255	0.296	0.389	0.409
8	0.273	0.233	0.296	0.584	0.320	0.317	0.349	0.432
9	0.287	0.285	0.358	0.506	0.270	0.218	0.296	0.370
10	0.261	0.284	0.310	0.412	0.336	0.288	0.328	0.323
11	0.311	0.245	0.410	0.544	0.276	0.269	0.479	0.487
12	0.327	0.347	0.491	0.488	0.370	0.335	0.425	0.455
13	0.282	0.228	0.274	0.339	0.329	0.341	0.333	0.420
14	0.439	0.340	0.390	0.441	0.340	0.330	0.368	0.330
15	0.415	0.417	0.407	0.498	0.458	0.444	0.411	0.463
16	0.167	0.206	0.240	0.377	0.269	0.283	0.288	0.397
17	0.208	0.202	0.252	0.403	0.321	0.311	0.277	0.317
18	0.262	0.258	0.338	0.472	0.300	0.340	0.330	0.387
19	0.436	0.328	0.310	0.567	0.401	0.473	0.420	0.391
20	0.402	0.421	0.493	0.650	0.522	0.367	0.418	0.467
Mean	0.328	0.303	0.371	0.506	0.338	0.343	0.368	0.413

Note:
The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

Table E.3.6 Maximum accelerations of 6-storey building (without GWB), (g)

No.	SAPWood											
	E-W						N-S					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.247	0.237	0.249	0.314	0.425	0.555	0.238	0.270	0.276	0.233	0.360	0.442
2	0.302	0.276	0.299	0.245	0.314	0.588	0.286	0.269	0.278	0.272	0.356	0.389
3	0.322	0.403	0.414	0.352	0.413	0.727	0.380	0.356	0.331	0.386	0.519	0.558
4	0.442	0.413	0.363	0.276	0.300	0.452	0.421	0.401	0.344	0.315	0.341	0.407
5	0.290	0.277	0.277	0.272	0.276	0.358	0.290	0.205	0.340	0.339	0.320	0.338
6	0.274	0.349	0.378	0.309	0.314	0.442	0.284	0.295	0.224	0.313	0.365	0.337
7	0.310	0.314	0.220	0.292	0.435	0.444	0.248	0.216	0.303	0.263	0.369	0.391
8	0.433	0.429	0.400	0.300	0.308	0.491	0.326	0.328	0.366	0.336	0.313	0.364
9	0.258	0.336	0.320	0.320	0.359	0.506	0.371	0.314	0.261	0.403	0.339	0.387
10	0.272	0.231	0.219	0.243	0.253	0.348	0.190	0.165	0.195	0.226	0.266	0.258
11	0.277	0.354	0.266	0.281	0.378	0.389	0.213	0.225	0.279	0.296	0.311	0.379
12	0.381	0.332	0.287	0.284	0.302	0.386	0.290	0.300	0.341	0.242	0.345	0.374
13	0.250	0.306	0.342	0.366	0.456	0.470	0.293	0.360	0.295	0.378	0.334	0.434
14	0.460	0.435	0.485	0.377	0.353	0.447	0.409	0.392	0.334	0.279	0.334	0.347
15	0.284	0.343	0.360	0.367	0.390	0.535	0.339	0.284	0.381	0.428	0.431	0.488
16	0.255	0.335	0.353	0.275	0.235	0.337	0.239	0.220	0.242	0.285	0.284	0.298
17	0.208	0.248	0.295	0.366	0.321	0.478	0.225	0.200	0.335	0.357	0.330	0.368
18	0.262	0.286	0.288	0.237	0.240	0.374	0.281	0.246	0.229	0.192	0.354	0.340
19	0.423	0.355	0.310	0.190	0.196	0.453	0.405	0.377	0.358	0.307	0.403	0.402
20	0.548	0.556	0.511	0.365	0.556	0.621	0.504	0.521	0.429	0.477	0.279	0.456
Mean	0.325	0.341	0.332	0.302	0.341	0.470	0.311	0.297	0.307	0.316	0.348	0.388

Note:
The acceleration is the moving average acceleration over 0.1 sec relative to stationary reference coordinates. The reason the moving average is used is that sudden spikes in acceleration over a very short time will not have significant impact on the contents or residents in the building, while the moving average value is felt to be more correlated with content damage and human comfort.

E.4 Maximum inter-storey drift

Table E.4.1 Inter-storey drift of 4-storey building in E-W direction (without GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 1				Wall 5				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	0.508	0.602	1.145	2.563	0.505	0.603	1.158	2.605	0.846	1.067	0.911	1.132
2	0.466	0.538	1.013	2.842	0.458	0.535	1.003	2.849	0.915	0.821	0.866	1.886
3	0.452	0.510	0.940	2.128	0.447	0.508	0.928	2.107	0.691	0.848	0.834	1.305
4	0.383	0.472	0.826	2.143	0.389	0.483	0.853	2.170	0.679	0.741	0.901	1.816
5	0.425	0.506	0.896	1.937	0.420	0.496	0.895	2.005	0.523	0.502	0.607	0.649
6	0.402	0.471	0.728	1.141	0.399	0.463	0.709	1.110	0.560	0.580	0.488	0.810
7	0.632	0.702	1.348	2.741	0.630	0.712	1.385	2.763	0.817	0.938	1.205	1.755
8	0.434	0.514	0.780	2.998	0.416	0.501	0.772	2.894	0.487	0.601	0.907	1.294
9	0.428	0.497	0.793	1.640	0.437	0.506	0.807	1.627	0.518	0.551	0.756	1.184
10	0.475	0.565	0.975	2.458	0.471	0.552	0.933	2.260	0.585	0.528	0.521	0.840
11	0.571	0.644	1.244	2.855	0.552	0.623	1.236	3.044	0.724	0.887	0.778	1.151
12	0.481	0.558	1.221	2.765	0.450	0.555	1.240	2.959	0.916	0.969	0.788	1.324
13	0.306	0.384	0.598	1.108	0.307	0.374	0.598	1.121	0.508	0.504	0.499	0.608
14	0.484	0.550	0.999	2.211	0.495	0.561	0.985	2.279	0.717	0.651	0.618	0.903
15	0.424	0.519	0.956	2.699	0.428	0.516	0.943	2.823	0.658	0.734	0.758	1.222
16	0.390	0.485	0.827	1.529	0.396	0.493	0.858	1.579	0.438	0.439	0.488	0.688
17	0.504	0.578	0.981	1.710	0.498	0.575	1.022	1.790	0.495	0.462	0.545	0.640
18	0.363	0.430	0.730	1.720	0.368	0.445	0.752	1.970	0.482	0.500	0.625	0.898
19	0.532	0.547	0.862	2.951	0.676	0.532	0.879	3.368	0.538	0.642	0.683	1.559
20	0.579	0.556	0.963	2.722	0.608	0.591	1.007	2.761	0.755	0.792	0.864	1.923
Mean	0.462	0.531	0.941	2.243	0.467	0.531	0.948	2.304	0.642	0.688	0.732	1.179

Note:
Storey height = 2750 mm

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Table E.4.2 Inter-storey drift of 4-storey building in N-S direction (without GWB), (%)

No.	Drain-3D								SAPWood			
	Wall 6				Wall 8				Center of the storey diaphragm			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	0.723	0.669	2.340	0.579	0.723	0.669	2.340	0.579	0.925	0.862	0.881	1.034
2	0.734	0.626	1.972	0.573	0.734	0.626	1.972	0.573	1.023	1.046	0.726	0.664
3	0.833	0.496	1.792	0.462	0.833	0.496	1.792	0.462	0.889	0.943	0.708	1.459
4	1.290	0.582	1.634	0.451	1.290	0.582	1.634	0.451	0.822	0.951	0.866	1.211
5	0.761	0.482	1.895	0.594	0.761	0.482	1.895	0.594	0.598	0.650	0.639	0.703
6	0.843	0.480	1.746	0.590	0.843	0.480	1.746	0.590	0.663	0.693	0.734	0.835
7	1.032	0.812	1.781	0.464	1.032	0.812	1.781	0.463	1.294	0.993	0.783	0.622
8	0.479	0.531	1.920	0.537	0.479	0.531	1.920	0.537	0.578	0.689	0.942	0.808
9	0.839	0.643	1.779	0.617	0.839	0.643	1.779	0.617	0.821	0.736	0.550	0.582
10	0.844	0.727	1.323	0.550	0.844	0.727	1.323	0.550	0.781	0.737	0.662	0.673
11	1.029	0.800	1.977	0.660	1.029	0.800	1.977	0.660	0.967	0.847	0.853	1.046
12	0.734	0.901	1.497	0.609	0.734	0.901	1.497	0.609	0.928	0.972	0.987	0.981
13	0.873	0.504	1.003	0.449	0.873	0.504	1.003	0.449	0.522	0.600	0.553	0.738
14	1.227	0.543	1.013	0.456	1.227	0.543	1.014	0.456	0.945	0.692	0.662	0.705
15	0.886	0.625	1.618	0.623	0.886	0.625	1.618	0.623	0.826	0.948	0.811	0.947
16	1.376	0.559	1.187	0.500	1.376	0.559	1.187	0.500	0.547	0.572	0.571	0.666
17	0.751	0.462	0.820	0.403	0.751	0.462	0.820	0.403	0.638	0.862	0.518	0.569
18	0.909	0.467	1.103	0.549	0.909	0.467	1.103	0.549	0.575	0.684	0.667	0.688
19	0.596	0.435	1.782	0.556	0.596	0.435	1.782	0.556	0.646	0.812	1.050	0.786
20	1.163	0.634	2.205	0.586	1.163	0.634	2.205	0.586	0.829	0.930	0.978	1.244
Mean	0.896	0.599	1.611	0.540	0.896	0.599	1.619	0.540	0.791	0.811	0.757	0.848

Note:
Storey height = 2750 mm

Table E.4.3 Inter-storey drift of 6-storey building in E-W direction (without GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 1						Wall 5						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.649	0.755	0.835	0.983	0.982	1.353	0.670	0.747	0.813	0.957	0.941	1.303	0.583	0.587	0.763	0.912	0.718	0.791
2	0.831	0.926	1.200	1.399	1.436	1.698	0.729	0.886	1.149	1.356	1.417	1.658	0.601	0.485	0.645	0.845	0.912	1.030
3	0.424	0.549	0.687	0.952	1.031	1.601	0.407	0.529	0.666	0.942	1.022	1.600	0.557	0.601	0.650	0.754	0.840	1.549
4	0.484	0.596	0.789	1.082	1.240	1.414	0.461	0.573	0.743	1.032	1.181	1.360	0.601	0.638	0.675	0.721	0.682	0.787
5	0.499	0.616	0.721	0.879	0.886	1.175	0.500	0.635	0.749	0.921	0.931	1.221	0.407	0.518	0.538	0.551	0.568	0.715
6	0.869	1.003	1.189	1.317	1.266	1.414	0.846	1.003	1.215	1.343	1.280	1.434	0.517	0.544	0.555	0.570	0.640	0.817
7	0.716	0.918	1.066	1.172	1.137	1.325	0.780	0.867	0.994	1.099	1.066	1.269	0.426	0.609	0.771	1.021	0.959	1.052
8	0.753	0.966	1.164	1.348	1.336	1.549	0.828	0.981	1.224	1.423	1.473	1.653	0.651	0.528	0.550	0.646	0.710	1.002
9	0.527	0.668	0.773	0.862	0.879	1.148	0.527	0.670	0.779	0.872	0.889	1.161	0.638	0.638	0.687	0.792	0.735	0.914
10	0.644	0.856	0.998	1.127	1.153	1.387	0.713	0.879	1.036	1.185	1.223	1.476	0.468	0.479	0.520	0.504	0.474	0.600
11	0.986	0.648	0.776	1.020	1.080	1.547	0.989	0.646	0.788	1.042	1.113	1.617	0.418	0.602	0.753	0.847	0.749	0.887
12	0.876	0.922	1.119	1.268	1.275	1.512	0.822	0.901	1.111	1.265	1.266	1.497	0.442	0.540	0.554	0.583	0.534	0.752
13	0.565	0.768	0.919	1.104	1.104	1.402	0.544	0.742	0.888	1.071	1.063	1.350	0.507	0.567	0.634	0.748	0.744	0.884
14	0.338	0.350	0.366	0.533	0.540	1.614	0.315	0.332	0.360	0.557	0.563	1.651	0.718	0.663	0.707	0.822	0.633	0.872
15	0.850	0.990	1.099	1.178	1.208	1.511	0.829	0.983	1.076	1.197	1.216	1.513	0.644	0.645	0.605	0.743	0.725	0.957
16	0.537	0.575	0.728	0.986	1.092	2.402	0.543	0.572	0.712	0.962	1.067	2.459	0.443	0.511	0.540	0.495	0.446	0.622
17	0.480	0.688	0.870	1.142	1.253	1.422	0.474	0.678	0.860	1.129	1.243	1.408	0.470	0.537	0.669	0.684	0.665	0.808
18	0.396	0.517	0.607	0.836	0.862	1.490	0.377	0.480	0.562	0.803	0.806	1.460	0.367	0.402	0.451	0.506	0.447	0.654
19	0.770	0.967	1.233	1.391	1.412	1.548	0.790	0.977	1.205	1.343	1.355	1.487	0.398	0.378	0.450	0.567	0.607	0.798
20	0.684	0.780	0.994	1.213	1.155	1.696	0.667	0.753	0.975	1.207	1.184	1.679	0.549	0.605	0.666	0.793	1.090	1.493
Mean	0.644	0.753	0.907	1.090	1.123	1.510	0.641	0.742	0.895	1.085	1.115	1.513	0.520	0.554	0.619	0.705	0.694	0.899

Note:
Storey height = 2750 mm

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Table E.4.4 Inter-storey drift of 6-storey building in N-S direction (without GWB), (%)

No.	Drain-3D												SAPWood					
	Wall 6						Wall 8						Center of the storey diaphragm					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	0.562	0.589	1.236	0.843	1.047	1.617	0.562	0.589	1.236	0.843	1.047	1.617	0.840	0.774	0.952	0.730	0.747	0.708
2	0.874	0.683	1.979	1.099	1.184	1.323	0.874	0.683	1.979	1.099	1.184	1.323	0.558	0.522	1.035	0.826	0.574	0.636
3	0.370	0.417	0.737	0.816	1.075	1.891	0.370	0.417	0.737	0.816	1.075	1.891	0.923	0.825	1.046	0.830	1.003	1.615
4	0.499	0.513	1.009	0.945	1.236	1.677	0.499	0.513	1.009	0.945	1.236	1.677	0.829	0.696	0.909	0.889	0.832	0.973
5	0.485	0.547	1.079	0.857	0.940	1.970	0.485	0.547	1.079	0.857	0.940	1.970	0.684	0.697	0.597	0.627	0.593	0.621
6	0.732	0.766	1.817	1.160	1.332	1.361	0.732	0.766	1.817	1.160	1.332	1.361	0.646	0.830	0.755	0.521	0.603	0.639
7	0.564	0.563	1.195	0.852	0.938	1.083	0.564	0.563	1.195	0.852	0.938	1.083	0.708	0.690	0.998	0.784	0.606	0.605
8	0.591	0.617	1.336	0.959	1.112	1.067	0.591	0.616	1.336	0.959	1.112	1.067	0.660	0.769	0.656	0.774	0.743	0.785
9	0.440	0.531	0.880	0.850	1.192	1.363	0.440	0.531	0.881	0.850	1.192	1.363	0.970	0.973	1.031	0.609	0.729	0.656
10	0.654	0.588	1.321	0.858	0.911	0.947	0.654	0.588	1.321	0.858	0.911	0.947	0.469	0.546	0.579	0.580	0.480	0.390
11	0.780	0.557	0.962	0.896	1.155	1.934	0.780	0.557	0.962	0.896	1.155	1.934	0.683	0.795	0.811	0.742	0.684	0.547
12	0.805	0.652	1.638	0.939	0.962	1.090	0.805	0.652	1.639	0.939	0.962	1.090	0.618	0.663	0.742	0.798	0.656	0.838
13	0.460	0.555	1.096	0.904	1.062	2.044	0.460	0.555	1.096	0.904	1.062	2.043	0.820	0.941	0.841	0.645	0.662	0.762
14	0.306	0.324	0.587	0.596	0.858	0.804	0.306	0.324	0.587	0.596	0.858	0.804	0.839	0.770	0.983	0.757	0.631	0.661
15	0.676	0.664	1.434	1.018	1.259	1.249	0.676	0.664	1.434	1.018	1.259	1.249	0.856	0.862	0.797	0.773	0.908	1.052
16	0.465	0.536	1.178	0.913	0.954	1.039	0.465	0.536	1.178	0.913	0.954	1.039	0.632	0.713	0.620	0.594	0.559	0.496
17	0.392	0.520	1.184	1.029	1.362	1.391	0.392	0.520	1.184	1.029	1.362	1.391	0.662	0.731	0.662	0.632	0.641	0.661
18	0.376	0.430	0.739	0.657	0.932	1.561	0.376	0.430	0.739	0.657	0.932	1.561	0.441	0.524	0.515	0.442	0.534	0.552
19	0.775	0.701	1.662	1.051	1.321	1.150	0.775	0.701	1.662	1.051	1.322	1.150	0.564	0.512	0.617	0.597	0.856	0.842
20	0.736	0.588	1.271	0.921	1.187	1.224	0.736	0.588	1.272	0.921	1.187	1.224	0.936	0.873	0.937	0.855	0.858	0.909
Mean	0.577	0.567	1.217	0.908	1.101	1.389	0.577	0.567	1.216	0.902	1.101	1.389	0.717	0.735	0.804	0.700	0.695	0.747

Note:
Storey height = 2750 mm

E.5 Maximum shear wall deformation at each storey

Table E.5.1 Shear wall deformation of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D							
	Wall 1				Wall 5			
	st1	st2	st3	st4	st1	st2	st3	st4
1	7.6	5.5	12.2	49.0	7.4	5.4	11.9	49.1
2	6.7	5.4	10.9	62.3	6.6	5.3	10.7	62.0
3	8.2	5.2	9.2	38.0	8.0	5.0	9.1	37.8
4	6.8	5.1	9.9	44.5	6.8	4.9	9.8	45.6
5	6.5	4.5	8.9	36.8	6.5	4.5	8.8	40.8
6	5.9	3.9	6.7	15.5	5.9	3.9	6.5	14.9
7	10.0	6.4	12.6	47.1	9.8	6.3	12.2	46.1
8	6.4	4.4	9.1	70.6	6.2	4.3	8.5	66.7
9	7.1	5.2	8.1	31.9	6.7	4.9	7.9	32.0
10	6.9	4.9	10.2	51.3	7.0	4.8	9.8	44.2
11	8.6	5.8	11.8	56.0	8.3	5.8	11.7	60.6
12	7.8	5.3	14.8	53.0	7.8	5.2	14.5	59.4
13	5.5	3.8	6.2	17.3	5.5	3.7	6.3	17.4
14	9.1	6.6	17.7	45.1	9.2	6.6	18.0	47.3
15	6.3	4.7	9.4	62.3	6.2	4.7	9.2	65.6
16	6.0	4.1	8.6	25.5	5.9	4.0	8.7	25.7
17	7.6	5.1	9.9	29.1	7.4	4.8	9.8	32.0
18	6.1	5.1	8.6	32.9	6.1	5.0	8.8	41.9
19	12.8	6.4	13.2	71.9	16.2	7.0	12.8	85.3
20	11.1	9.1	14.7	69.8	11.7	9.6	16.9	71.0
Mean	7.6	5.3	10.6	45.5	7.8	5.3	10.6	47.3

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Table E.5.2 Shear wall deformation of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D							
	Wall 6				Wall 8			
	st1	st2	st3	st4	st1	st2	st3	st4
1	18.3	13.3	60.0	10.6	18.3	13.7	60.0	10.7
2	17.0	11.8	48.9	10.7	17.3	12.3	49.7	10.8
3	21.3	9.6	43.9	7.9	21.3	9.5	43.9	8.2
4	32.8	12.0	40.5	7.4	33.1	11.9	40.5	7.5
5	18.4	9.4	46.5	10.4	18.7	9.4	46.5	10.5
6	20.7	9.5	44.7	10.8	20.9	9.4	44.7	10.9
7	25.9	17.3	42.7	7.7	25.9	17.8	43.4	8.4
8	12.8	9.8	47.6	10.9	12.7	10.3	48.3	11.0
9	19.9	13.6	43.8	10.6	20.2	13.5	43.8	10.7
10	20.0	14.8	30.2	9.0	20.4	15.3	30.9	9.1
11	25.8	16.4	48.2	9.9	25.8	17	49.2	10.9
12	17.5	20.1	36.4	10.0	17.4	20.0	36.4	10.1
13	21.6	10.2	22.9	6.5	21.6	10.1	22.9	7.1
14	31.2	11.9	24.3	7.3	31.1	12.4	24.3	7.7
15	21.8	13.0	38.0	9.8	21.7	12.9	38.6	10.5
16	35.4	11.8	27.9	7.6	35.4	11.7	28.6	8.3
17	18.2	8.7	17.0	6.2	18.4	8.8	17.6	6.7
18	23.0	9.6	24.5	9.4	22.9	9.9	25.2	10.0
19	16.3	7.8	46.0	11.5	16.2	8.3	46.6	11.6
20	30.3	11.7	55.4	8.5	30.3	12.4	56.5	9.0
Mean	22.4	12.1	39.5	9.1	22.5	12.1	39.9	9.5

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Table E.5.3 Shear wall deformation of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D											
	Wall 1						Wall 5					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	10.9	8.2	6.8	7.3	5.2	13.7	11.2	8.3	6.7	7.3	4.7	13.4
2	13.8	8.8	8.0	8.9	7.4	13.0	11.6	8.3	7.9	8.7	7.7	12.8
3	7.5	6.5	5.3	7.5	7.4	22.3	7.1	6.3	5.0	7.1	7.0	21.9
4	8.8	6.4	5.7	8.1	9.2	15.8	8.6	6.5	5.2	7.9	8.9	15.1
5	8.2	7.0	6.3	6.9	5.2	11.4	8.1	7.0	6.3	6.9	5.2	11.8
6	14.5	11.3	9.5	9.2	5.7	10.9	13.8	11.0	9.4	9.0	5.2	10.7
7	12.6	9.3	8.4	7.9	5.5	12.4	14.3	8.9	7.7	7.4	5.2	12.8
8	13.9	11.1	9.2	9.0	6.8	10.0	10.5	9.3	9.2	4.3	7.4	11.1
9	8.1	7.1	6.6	6.9	5.1	10.5	8.0	6.9	6.4	6.7	4.9	10.3
10	9.7	9.0	8.4	8.2	5.8	10.1	11.6	9.1	8.3	8.2	6.1	10.8
11	21.8	8.2	6.3	7.9	8.7	25.4	21.6	8.2	6.4	8.2	9.1	27.0
12	16.4	9.1	8.1	9.0	6.1	9.8	14.8	8.8	8.3	9.1	6.0	9.7
13	8.0	7.5	7.2	8.5	6.1	12.3	8.4	7.2	7.0	8.0	5.2	11.2
14	7.6	6.3	5.6	6.2	5.5	33.1	7.8	6.2	5.6	6.1	5.3	33.2
15	14.6	11.7	9.0	8.6	7.5	13.8	14.1	11.7	9.2	8.3	7.1	13.1
16	10.0	6.8	6.2	8.4	9.9	48.6	10.3	6.9	6.1	8.2	9.8	50.6
17	7.1	6.4	5.6	9.0	8.8	11.8	7.1	6.4	5.6	8.6	8.5	11.5
18	7.9	5.9	5.3	8.7	7.4	21.7	8.3	6.0	4.9	8.5	7.7	21.6
19	12.9	10.7	8.8	9.0	7.1	9.5	10.3	8.8	9.1	7.2	9.3	9.6
20	12.2	8.5	9.8	12.7	9.7	20.4	11.9	8.2	9.5	12.6	9.7	20.5
Mean	11.3	8.3	7.3	8.4	7.0	16.8	11.0	8.0	7.2	7.9	7.0	16.9

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Table E.5.4 Shear wall deformation of 6-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D											
	Wall 6						Wall 8					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	11.1	8.2	24.4	12.2	15.9	30.9	11.2	8.7	25.1	12.0	15.8	30.9
2	19.3	9.5	41.8	15.6	16.7	19.0	19.3	9.4	41.7	15.4	16.6	19.0
3	8.3	7.1	13.7	12.0	17.9	42.8	8.3	7.0	13.5	12.5	18.5	42.8
4	10.3	8.5	18.8	14.6	21.9	40.3	10.2	8.4	18.6	14.5	21.8	40.3
5	9.9	8.5	19.7	11.6	13.9	42.8	9.8	8.4	20.2	12.1	13.8	42.8
6	15.1	8.5	33.4	13.4	16.0	16.3	15.2	9.2	34.8	14.6	17.4	17.5
7	11.2	8.2	23.8	12.2	13.0	16.5	11.4	8.5	24.2	12.0	12.9	16.5
8	12.2	8.7	24.3	12.2	14.1	12.6	12.2	8.6	25.3	12.7	15.3	13.5
9	8.5	7.1	14.7	12.1	18.5	25.5	8.6	7.5	15.3	12.6	19.1	26.2
10	13.9	8.7	26.8	12.2	12.5	13.0	13.8	8.8	26.6	12.1	12.5	13.0
11	17.9	9.6	17.6	13.9	21.9	44.2	17.9	9.5	17.5	13.7	21.8	44.8
12	17.6	10.4	34.3	12.8	12.3	14.8	17.7	10.3	34.2	12.7	12.2	14.8
13	8.3	7.4	18.9	12.2	13.4	39.5	8.4	7.7	19.7	12.1	14.5	40.4
14	7.9	5.9	12.7	10.4	15.1	21.1	8.0	5.9	13.1	10.9	15.6	21.5
15	14.4	8.8	29.8	12.7	17.3	20.0	14.3	8.7	29.7	13.0	18.1	20.1
16	9.7	9.0	24.8	15.9	14.8	26.5	9.7	8.9	24.7	15.7	15.4	26.6
17	7.1	6.9	20.8	14.1	20.8	21.8	7.0	7.1	21.8	15.1	22.1	23.0
18	8.7	7.5	14.4	10.3	17.0	35.2	8.7	7.4	14.3	10.2	16.9	35.7
19	16.4	9.1	31.4	13.9	20.6	13.2	16.5	9.2	32.3	13.8	20.5	13.9
20	16.6	9.5	26.4	14.9	21.6	23.5	16.8	9.4	26.3	14.7	21.5	24.1
Mean	12.2	8.3	23.6	13.0	16.8	26.0	12.3	8.4	23.9	13.1	17.1	26.4

E.6 Maximum uplift forces and deformations

Table E.6.1 Maximum uplift forces of 4-storey building in E-W direction (without GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 1				Wall 5				Wall 5 - method A				Wall 5 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	245.7	180.4	115.2	49.3	252.0	184.6	115.2	49.3	124.7	84.7	47.9	18.7	46.1	37.6	29.9	33.4
2	233.7	173.4	115.2	50.5	233.0	172.8	115.2	50.5	192.4	108.8	62.8	31.1	49.3	48.8	39.2	33.6
3	210.4	165.2	115.1	45.6	210.6	165.2	115.1	45.5	135.6	109.4	57.7	23.0	37.2	42.7	37.6	34.0
4	197.8	153.5	115.1	47.9	203.8	157.5	115.1	48.3	102.9	86.4	45.2	17.5	39.8	35.7	42.7	37.6
5	211.9	161.8	115.1	44.6	210.3	161.7	115.1	45.8	74.5	59.1	38.7	17.8	21.1	22.0	29.6	24.5
6	197.2	143.5	106.8	37.8	195.7	141.7	105.5	37.6	75.4	54.8	35.0	14.0	28.4	25.3	22.2	27.7
7	283.6	190.3	115.2	48.8	289.9	190.3	115.2	48.4	91.4	77.8	43.6	16.7	26.4	20.6	34.7	33.0
8	211.7	156.8	115.1	50.9	207.2	155.8	115.1	50.8	112.6	83.4	49.3	27.0	24.1	32.5	42.9	31.1
9	206.0	148.9	115.1	42.8	216.0	155.1	115.1	42.9	109.3	65.1	40.7	19.3	29.1	30.3	29.2	27.4
10	234.7	169.3	115.1	49.6	231.8	166.2	115.1	47.7	85.9	59.7	34.2	14.8	28.9	23.4	23.6	28.1
11	272.5	190.2	115.2	50.1	268.0	190.2	115.2	50.3	170.9	95.4	56.5	23.9	39.5	47.8	37.1	32.0
12	228.3	180.1	115.2	50.0	224.3	184.4	115.2	50.2	135.3	86.4	53.3	21.6	58.2	55.6	36.2	36.0
13	152.0	114.0	93.6	38.3	159.1	119.3	96.5	38.3	75.6	66.4	37.6	15.0	21.8	25.5	22.6	24.1
14	189.7	138.0	115.1	47.7	199.7	139.9	115.1	48.4	96.9	84.2	49.0	21.8	45.6	42.6	34.5	26.6
15	214.7	166.7	115.1	49.4	216	165.6	115.1	49.3	111.0	92.1	44.8	20.2	35.3	38.2	39.3	33.1
16	198.1	151.1	115.1	41.3	207.7	158.0	115.1	41.3	69.1	53.7	29.6	12.0	16.4	21.3	24.0	25.2
17	238.0	169.3	115.1	42.5	243.9	174.6	115.1	43.5	81.3	61.2	34.1	16.0	19.8	25.9	18.9	25.9
18	180	142.3	112.5	43.6	187.0	146.5	114.8	46.5	83.6	61.7	34.5	17.0	19.8	20.1	24.3	29.0
19	205.2	157.0	115.1	50.5	198.4	153.2	115.1	50.5	115.0	96.5	57.6	32.6	26.2	40.3	37.8	35.8
20	209.1	161.0	115.1	50.7	224.2	170.8	115.1	50.8	141.7	109.7	57.3	28.7	47.1	42.6	45.4	40.0
Mean	217.9	160.6	113.5	46.6	219.1	162.7	113.7	46.8	109.3	79.8	45.5	20.4	33.0	33.9	32.6	30.9

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Table E.6.2 Maximum uplift forces of 4-storey building in N-S direction (without GWB), (kN)

No.	Drain-3D								SAPWood							
	Wall 6				Wall 8				Wall 8 - method A				Wall 8 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	113.6	74.8	35.8	10.1	97.9	64.3	33.1	6.8	49.8	33.5	15.8	15.4	18.6	26.2	28.7	14.2
2	115.1	77.8	37.6	9.9	103.1	67.6	32.4	7.1	60.4	47.1	24.4	27.2	30.7	28.2	24.4	10.8
3	95.6	57.7	31.6	5.8	85.9	54.7	26.0	5.3	54.9	42.9	19.7	18.9	28.9	31.5	25.5	15.3
4	107.4	65.6	28.2	4.9	91.8	55.4	25.6	3.2	42.1	32.6	15.7	14.3	24.2	31.5	28.2	15.1
5	100.4	62.9	34.1	9.8	86.2	60.7	31.4	8.2	30.3	24.1	14.9	13.7	15.2	20.6	22.0	11.8
6	104.2	64.8	37.6	9.8	89.3	55.1	31.6	8.3	29.5	21.2	11.4	12.1	15.5	19.5	25.0	12.3
7	112.6	73.6	34.0	5.8	97.1	63.0	28.5	5.4	38.7	33.4	15.4	15.1	2.2	4.6	4.6	3.6
8	100.8	74.7	39.9	10.0	85.8	64.2	34.3	6.8	44.0	32.4	18.2	22.1	12.9	19.0	29.6	11.3
9	115.1	73.9	38.5	10.0	100.1	63.4	33.0	7.2	30.8	24.0	14.2	15.4	18.5	20.3	16.9	8.3
10	115.1	73.4	32.3	8.2	100.7	62.9	26.9	5.3	33.4	23.1	12.7	12.6	16.8	23.7	23.4	11.6
11	115.1	83.0	42.4	10.8	103.9	71.7	35.7	9.2	45.2	34.6	18.8	17.6	27.3	23.7	24.3	13.8
12	101.3	67.2	37.8	9.6	99.9	65.1	32.2	7.1	54.8	36.4	18.4	16.9	29.2	31.5	28.8	14.7
13	97.5	58.8	28.3	3.4	83.4	49.9	22.9	2.8	29.4	24.9	14.1	13.3	13.0	17.1	20.8	12.3
14	94.1	64.8	30.6	4.7	92.8	54.4	25.1	4.3	36.8	30.1	16.7	17.4	30.4	24.0	24.1	11.9
15	111.5	72.3	40.4	10.5	96.0	62.0	33.8	8.9	44.5	32.3	14.3	16.3	24.9	29.9	26.9	14.4
16	103.3	63.3	33.0	6.0	87.9	52.6	27.5	5.6	27.5	19.9	10.3	9.7	9.9	14.1	18.0	11.8
17	96.9	56.0	26.8	2.7	82.5	46.7	21.2	2.0	34.2	26.0	12.4	13.1	20.5	29.0	20.0	10.1
18	99.4	64.9	36.2	9.7	84.9	53.6	29.7	8.3	34.1	25.6	13.3	14.1	9.9	20.5	20.9	10.8
19	87.8	62.1	36.0	10.5	73.3	52.2	29.3	8.8	47.5	38.7	21.7	26.2	17.0	26.3	30.2	12.5
20	115.1	78.6	38.5	7.5	106.9	69.0	33.7	7.5	55.0	43.0	20.0	21.5	25.3	28.0	29.4	15.2
Mean	105.1	68.5	35.0	8.0	92.5	59.4	29.7	6.4	41.2	31.3	16.1	16.7	19.6	23.5	23.6	12.1

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Table E.6.3 Maximum uplift deformation of 4-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 1				Wall 5				Wall 5 - method A				Wall 5 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	5.3	3.9	11.0	3.4	5.4	4.0	12.0	3.4	2.67	1.61	1.51	1.29	0.99	1.18	0.94	2.32
2	5.0	3.7	12.7	3.5	5.0	3.7	12.6	3.5	4.11	2.07	1.97	2.15	1.06	1.54	1.23	2.33
3	4.5	3.5	8.4	3.2	4.5	3.5	8.2	3.2	2.90	2.08	1.81	1.59	0.80	1.34	1.18	2.36
4	4.2	3.3	4.8	3.3	4.4	3.4	5.4	3.4	2.20	1.64	1.42	1.21	0.85	1.12	1.34	2.61
5	4.5	3.5	7.1	3.1	4.5	3.5	7.5	3.2	1.59	1.12	1.22	1.23	0.45	0.69	0.93	1.70
6	4.2	3.1	3.8	2.6	4.2	3.0	3.7	2.6	1.61	1.04	1.10	0.97	0.61	0.80	0.70	1.92
7	6.1	5.2	16.5	3.4	6.2	5.9	17.6	3.4	1.96	1.48	1.37	1.16	0.56	0.65	1.09	2.29
8	4.5	3.4	5.2	3.5	4.4	3.3	5.3	3.5	2.41	1.59	1.55	1.87	0.52	1.02	1.35	2.16
9	4.4	3.2	4.2	3.0	4.6	3.3	4.7	3.0	2.34	1.24	1.28	1.34	0.62	0.95	0.92	1.90
10	5.0	3.6	7.2	3.4	5.0	3.6	6.5	3.3	1.84	1.14	1.08	1.03	0.62	0.74	0.74	1.95
11	5.8	4.2	14.7	3.5	5.7	4.1	14.9	3.5	3.66	1.81	1.78	1.66	0.84	1.50	1.17	2.22
12	4.9	3.9	11.6	3.5	4.8	4.0	13.6	3.5	2.89	1.64	1.68	1.50	1.24	1.75	1.14	2.49
13	3.3	2.4	3.3	2.7	3.4	2.6	3.4	2.7	1.62	1.26	1.18	1.04	0.47	0.80	0.71	1.67
14	4.1	3.0	5.0	3.3	4.3	3	4.9	3.4	2.07	1.60	1.54	1.51	0.98	1.34	1.08	1.84
15	4.6	3.6	9.3	3.4	4.6	3.6	9.4	3.4	2.38	1.75	1.41	1.40	0.76	1.20	1.23	2.29
16	4.2	3.2	4.5	2.9	4.5	3.4	5.5	2.9	1.48	1.02	0.93	0.83	0.35	0.67	0.75	1.75
17	5.1	3.6	7.3	3.0	5.2	3.7	8.9	3.0	1.74	1.16	1.07	1.11	0.42	0.81	0.60	1.79
18	3.9	3.1	4.0	3.0	4.0	1.4	3.1	1.3	1.79	1.17	1.08	1.18	0.42	0.63	0.76	2.01
19	4.4	3.4	6.8	3.5	4.3	3.3	6.1	3.5	2.46	1.83	1.81	2.26	0.56	1.27	1.19	2.48
20	4.5	3.5	7.3	3.5	4.8	3.7	8.6	3.5	3.03	2.09	1.80	1.99	1.01	1.34	1.43	2.77
Mean	4.6	3.5	7.7	3.2	4.7	3.5	8.1	3.2	2.34	1.52	1.43	1.42	0.71	1.07	1.02	2.14

Table E.6.4 Maximum uplift deformation of 4-storey building in N-S direction (without GWB), (mm)

No.	Drain-3D								SAPWood							
	Wall 6				Wall 8				Wall 8 - method A				Wall 8 - method B			
	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4	st1	st2	st3	st4
1	4.0	2.7	2.5	0.7	3.5	2.3	2.3	0.5	1.76	1.05	0.97	1.07	0.66	1.61	1.77	0.98
2	4.4	2.8	2.6	0.7	3.7	2.4	2.2	0.5	2.14	1.48	1.50	1.89	1.08	1.74	1.50	0.75
3	3.4	2.0	2.2	0.4	3.0	1.9	1.8	0.4	1.94	1.35	1.22	1.31	1.02	1.94	1.57	1.06
4	3.8	2.3	2.0	0.3	3.3	2.0	1.8	0.2	1.49	1.02	0.97	0.99	0.86	1.94	1.74	1.05
5	3.6	2.2	2.4	0.7	3.1	2.2	2.2	0.6	1.07	0.76	0.92	0.95	0.54	1.27	1.36	0.82
6	3.7	2.3	2.6	0.7	3.2	2.0	2.2	0.6	1.04	0.67	0.70	0.84	0.55	1.20	1.54	0.85
7	4.0	2.6	2.4	0.4	3.4	2.2	2.0	0.4	1.37	1.05	0.95	1.05	0.08	0.29	0.28	0.25
8	3.6	2.6	2.8	0.7	3.0	2.3	2.4	0.5	1.56	1.02	1.12	1.53	0.46	1.17	1.82	0.78
9	4.2	2.6	2.7	0.7	3.5	2.2	2.3	0.5	1.09	0.75	0.88	1.07	0.65	1.25	1.04	0.58
10	4.2	2.6	2.2	0.6	3.6	2.2	1.9	0.4	1.18	0.73	0.78	0.87	0.60	1.46	1.44	0.80
11	4.6	2.9	2.9	0.7	3.7	2.5	2.5	0.6	1.60	1.09	1.16	1.22	0.96	1.46	1.50	0.95
12	3.6	2.4	2.6	0.7	3.5	2.3	2.2	0.5	1.94	1.14	1.13	1.17	1.03	1.94	1.77	1.02
13	3.5	2.1	2.0	0.2	3.0	1.8	1.6	0.2	1.04	0.78	0.87	0.93	0.46	1.06	1.28	0.85
14	3.3	2.3	2.1	0.3	3.3	1.9	1.7	0.3	1.30	0.95	1.03	1.20	1.07	1.48	1.48	0.83
15	4.0	2.6	2.8	0.7	3.4	2.2	2.3	0.6	1.57	1.01	0.88	1.13	0.88	1.84	1.65	1.00
16	3.7	2.2	2.3	0.4	3.1	1.9	1.9	0.4	0.97	0.63	0.63	0.67	0.35	0.87	1.11	0.82
17	3.4	2.0	1.9	0.2	2.9	1.7	1.5	0.1	1.21	0.82	0.76	0.91	0.73	1.78	1.23	0.70
18	3.5	2.3	2.5	0.7	3.0	1.9	2.1	0.6	1.21	0.81	0.82	0.98	0.35	1.26	1.29	0.75
19	3.1	2.2	2.5	0.7	2.6	1.9	2.0	0.6	1.68	1.22	1.34	1.82	0.60	1.62	1.86	0.86
20	4.9	2.8	2.7	0.5	3.8	2.4	2.3	0.5	1.95	1.35	1.23	1.49	0.89	1.72	1.81	1.06
Mean	3.8	2.4	2.4	0.6	3.3	2.1	2.1	0.4	1.46	0.98	0.99	1.15	0.69	1.44	1.45	0.84

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Table E.6.5 Maximum uplift forces of 6-storey building in E-W direction (without GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 1						Wall 5						Wall 5 - method A						Wall 5 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	295.2	218.7	170.1	135.3	98.3	82.2	299.8	214.9	166.1	132.3	81.0	82.0	147.5	125.1	98.5	86.7	80.9	50.7	37.4	41.5	41.9	52.8	35.6	36.9
2	223.9	198.9	176.1	155.0	113.8	88.7	225.6	201.8	179.9	158.3	115.6	88.4	130.8	195.3	145.5	107.0	78.4	48.3	39.7	32.9	28.1	31.8	27.2	37.4
3	260.2	230.2	190.3	167.3	116.4	83.9	250.5	221.9	190.2	164.0	101.3	83.4	147.8	115.9	88.0	86.7	78.7	42.9	38.9	48.2	41.0	39.2	39.5	50.2
4	252.4	195.5	154.9	128.0	93.5	80.1	264.6	210.5	166.5	135.9	97.3	80.7	120.2	91.8	75.6	70.9	70.0	55.1	39.5	54.8	44.6	47.4	41.2	39.9
5	382.2	291.7	190.3	140.2	96.0	79.8	391.9	298.7	190.3	142.0	97.5	79.6	81.3	73.0	53.6	52.4	51.6	35.3	26.8	45.4	38.8	38.4	26.7	27.0
6	370.2	279.8	190.2	129.8	94.8	81.2	352	265.0	181.6	125.0	90.2	81.5	112.6	81.5	70.4	76.8	57.3	38.9	42.4	46.3	35.4	37.4	27.5	34.4
7	262.6	196.6	156.6	126.3	95.1	79.2	272.1	204.5	155.0	130.6	96.5	78.9	72.6	77.8	44.7	43.6	52.7	43.3	38.6	34.4	27.4	28.1	24.4	18.2
8	266.9	221.8	190.2	164.6	119.1	90.5	272.4	227.6	190.3	168.1	109.8	91.8	101.1	102.8	83.3	86.1	77.8	47.2	52.0	40.0	26.1	33.0	32.5	41.1
9	374.0	292.5	190.3	149.4	98.1	77.5	370.3	290.8	190.3	149.8	90.9	77.0	150.8	139.1	90.5	87.7	71.8	40.1	52.9	49.9	33.8	37.6	31.5	37.4
10	372.5	279.8	190.3	154.5	107.9	82.3	370.3	279.5	190.3	157.8	109.2	81.7	101.9	82.0	64.2	68.1	54.7	32.4	34.3	35.5	29.5	27.0	20.5	22.3
11	290.2	243.7	190.3	161.9	106.9	80.6	291.5	245.3	190.3	164	108.1	80.4	129.4	136.8	76.8	68.8	54.8	31.8	35.6	49.3	37.5	38.0	27.3	28.2
12	203.2	175.2	152.5	130.4	98.9	88.6	193.8	164.3	143.2	123.4	92.8	89.3	98.7	79.9	69.8	90.6	73.4	53.4	33.5	45.1	35.7	36.0	27.8	36.3
13	388.0	297.7	190.3	158.0	102.4	75.6	384.8	295.0	190.3	156.8	82.9	76.5	114.3	91.9	71.1	62.5	60.1	41.1	41.8	45.1	34.3	42.4	35.1	39.1
14	301.0	237.5	190.3	166.8	114.5	87.5	295.3	237.6	190.3	169.4	103.6	87.7	133.5	115.3	99.6	102.7	89.5	44.5	58.8	53.0	42.6	43.1	36.6	40.1
15	382.5	300.5	190.3	159.6	105.4	81.6	371.1	294.4	190.3	161.0	81.1	81.5	139.5	114.6	92.6	89.1	73.8	36.3	48.1	44.9	34.7	36.4	30.0	38.8
16	380.0	296.4	190.3	153.8	98.7	78.3	389.0	307.2	190.3	160.1	104.0	80.0	80.6	69.4	57.2	63.6	59.6	35.1	37.7	46.2	27.2	19.9	16.4	31.1
17	346.6	267.3	190.3	145.5	99.1	78.5	358.9	280.6	190.3	151.4	82.6	79.7	116.0	92.9	67.9	65.6	62.5	32.8	33.8	39.9	27.5	33.4	25.5	36.7
18	314.4	245.4	185.0	141.5	95.0	80.8	311.3	244.1	184.9	142.8	95.9	79.7	71.5	65.8	53.2	64.1	69.7	42.1	28.2	30.0	33.0	21.2	16.1	32.2
19	126.1	100.8	110.6	106.0	99.2	97.6	119.9	107.8	119.5	112.2	102.4	97.7	96.1	83.3	72.5	75.4	72.8	44.6	31.4	27.4	27.5	29.5	30.3	40.0
20	227.9	204.0	190.2	177.4	145.3	108.9	227.1	200.9	190.2	177.1	109.2	110.3	130.5	131.4	113.7	121.4	95.1	60.2	49.6	42.5	33.2	41.1	45.5	51.2
Mean	301.0	238.7	179.0	147.6	104.9	84.2	297.9	239.6	179.0	148.3	97.6	84.4	113.8	103.3	79.4	78.5	69.3	42.8	40.0	42.6	34.0	35.7	29.9	35.9

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Table E.6.6 Maximum uplift forces of 6-storey building in N-S direction (without GWB), (kN)

No.	Drain-3D												SAPWood											
	Wall 6						Wall 8						Wall 8 - method A						Wall 8 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	280.6	190.3	134.7	84.8	44.5	11.5	266.4	190.2	126.3	83.2	42.8	10.1	98.3	85.1	66.2	38.2	17.2	10.9	7.7	29.0	30.7	31.7	31.1	17.4
2	200.8	164.8	137.9	95.7	48.3	13.6	184.9	152.6	128.6	90.1	45.8	13.3	82.9	72.2	62.3	39.0	18.2	12.4	18.9	24.4	31.4	33.2	28.4	14.1
3	226.7	182.7	145.5	94.1	46.5	11.9	225.9	181.7	144.8	93.0	44.8	10.1	98.4	75.3	56.3	35.6	17.2	9.0	30.1	34.3	32.6	34.0	36.4	22.4
4	262.7	190.3	147.1	91.5	43.9	13.4	246.9	185.0	138.7	87.4	42.0	12.0	81.9	64.2	53.1	31.4	15.4	12.6	25.5	30.0	29.6	35.1	33.6	19.6
5	314.0	190.4	164.0	97.2	44.3	7.9	305.1	190.3	155.0	92.8	43.0	8.7	54.1	44.9	35.6	21.8	11.4	8.2	12.8	22.0	15.4	27.2	25.1	15.3
6	267	190.2	131.4	80.3	37.6	8.3	250.0	180.1	130.4	78.7	36.6	7.9	76.4	58.2	45.8	25.9	12.9	8.7	15.0	33.6	24.4	20.8	24.3	16.4
7	261.3	190.3	141.3	97.5	48.8	8.9	246.9	186.0	132.2	91.9	46.3	10.0	45.6	36.7	29.0	19.7	11.3	10.8	1.8	7.5	16.0	18.6	9.1	7.1
8	237.9	183.6	143.8	93.6	47.5	12.5	237.5	182.8	142.9	92.3	45.1	14.2	67.3	68.5	54.9	34.6	16.5	11.0	12.6	24.7	19.4	28.5	25.9	18.5
9	292.3	190.3	143.6	84.7	39.1	8.1	280.0	190.3	142.6	83.1	37.4	7.8	100.6	77.3	59.9	35.7	15.3	8.8	31.4	33.5	27.1	25.3	25.6	15.2
10	293.4	190.3	153.0	90.4	42.9	9.2	285.4	190.3	146.6	88.6	42.0	8.2	72.2	61.6	48.0	32.0	12.5	7.5	7.9	21.0	16.5	24.9	18.5	11.3
11	263.9	190.3	166.8	105.7	50.3	7.4	248.9	190.3	155.4	99.2	48.1	10.0	84.7	66.3	50.4	28.9	12.1	7.6	20.3	29.0	28.5	31.6	24.4	14.1
12	163.5	126.3	95.6	69.0	42.3	11.4	162.5	125.2	94.5	67.4	40.6	11.8	67.2	55.6	49.0	37.5	16.0	11.6	9.8	20.4	24.2	32.6	28.4	17.5
13	309.7	190.3	155.4	89.8	41.8	7.8	299.5	190.3	149.0	88.2	41.3	7.7	75.7	60.7	48.1	26.7	13.0	9.3	30.2	37.8	26.6	29.0	27.9	18.0
14	247.4	185.2	147.9	92.9	43.3	9.7	247.1	184.4	147.2	91.7	41.5	9.3	86.0	75.4	64.5	42.2	18.9	9.5	38.5	36.5	33.7	31.8	27.9	16.2
15	297.6	190.3	156.4	93.3	43.0	9.1	297.8	190.3	155.9	92.2	41.3	7.6	91.5	75.4	60.8	36.4	15.1	8.4	32.7	29.3	32.7	32.2	29.6	20.5
16	292.1	190.3	149.4	90.6	44.0	6.3	279.8	190.3	143.3	88.6	42.3	7.8	59.0	50.9	42.6	27.9	13.8	7.7	11.5	23.8	18.2	25.9	24.7	13.0
17	279.2	190.3	133.9	82.7	39.4	7.8	263.3	189.3	132.7	81.0	37.6	6.2	78.9	56.0	45.3	27.2	13.3	8.5	18.4	23.1	21.8	26.3	24.8	16.5
18	274.5	190.3	153.8	96.3	50.4	10.8	261	190.3	145.8	93.3	48.3	13.3	47.0	38.7	35.3	26.2	15.0	9.6	0.0	10.5	11.3	14.9	18.6	14.4
19	131.8	115.9	90.1	62.7	31.8	13.5	118.0	103.5	80.4	56.9	30.6	13	69.7	60.5	51.6	32.8	16.5	10.7	5.1	8.2	20.2	24.2	33.4	17.9
20	212.4	164.7	139.6	96.2	51.7	15.0	211.5	163.5	131.0	90.6	49.2	15.5	89.4	85.7	77.7	48.8	20.4	14.1	26.3	30.8	30.0	31.6	32.0	19.5
Mean	254.8	179.8	141.5	89.5	44.1	10.2	245.1	177.3	136.2	86.5	42.3	10.1	76.3	63.5	51.8	32.4	15.1	9.8	17.8	25.5	24.5	28.0	26.5	16.2

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Table E.6.7 Maximum uplift deformation of 6-storey building in E-W direction (without GWB), (mm)

No.	Drain-3D												SAPWood											
	Wall 1						Wall 5						Wall 5 - method A						Wall 5 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	6.3	4.7	3.6	2.9	2.1	1.8	6.4	4.6	3.6	2.8	2.1	1.8	3.15	2.38	1.87	1.65	1.54	1.08	0.80	0.79	0.80	1.00	0.68	0.79
2	4.8	4.3	3.8	3.3	2.4	1.9	4.8	4.3	3.9	3.4	2.5	1.9	2.80	3.71	2.77	2.03	1.49	1.03	0.85	0.62	0.53	0.61	0.52	0.80
3	5.6	4.9	4.6	3.6	2.5	1.8	5.4	4.8	4.2	3.5	2.3	1.8	3.16	2.20	1.67	1.65	1.50	0.92	0.83	0.92	0.78	0.75	0.75	1.07
4	5.4	4.2	3.3	2.7	2.0	1.7	5.7	4.5	3.6	2.9	2.1	1.7	2.57	1.75	1.44	1.35	1.33	1.18	0.85	1.04	0.85	0.90	0.78	0.85
5	8.2	6.3	6.9	3.0	2.1	1.7	8.4	6.4	8.1	3.0	2.1	1.7	1.74	1.39	1.02	1.00	0.98	0.76	0.57	0.86	0.74	0.73	0.51	0.58
6	7.9	6.0	4.1	2.8	2.0	1.7	7.5	5.7	3.9	2.7	2.1	1.7	2.41	1.55	1.34	1.46	1.09	0.83	0.91	0.88	0.67	0.71	0.52	0.73
7	5.6	4.2	3.4	2.7	2.0	1.7	5.8	4.4	3.3	2.8	2.1	1.7	1.55	1.48	0.85	0.83	1.00	0.93	0.82	0.65	0.52	0.53	0.46	0.39
8	5.7	4.8	4.1	3.5	2.6	1.9	5.8	4.9	4.4	3.6	2.4	2.0	2.16	1.95	1.58	1.64	1.48	1.01	1.11	0.76	0.50	0.63	0.62	0.88
9	8.0	6.3	6.8	3.2	2.1	1.7	7.9	6.2	6.9	3.2	2.2	1.7	3.23	2.64	1.72	1.67	1.36	0.86	1.13	0.95	0.64	0.72	0.60	0.80
10	8.0	6.0	4.6	3.3	2.3	1.8	7.9	6.0	5.0	3.4	2.3	1.8	2.18	1.56	1.22	1.29	1.04	0.69	0.73	0.67	0.56	0.51	0.39	0.48
11	6.2	5.2	4.7	3.5	2.3	1.7	6.3	5.3	5.0	3.5	2.3	1.7	2.77	2.60	1.46	1.31	1.04	0.68	0.76	0.94	0.71	0.72	0.52	0.60
12	4.4	3.8	3.3	2.8	2.1	1.9	4.2	3.5	3.1	2.6	2.0	1.9	2.11	1.52	1.33	1.72	1.40	1.14	0.72	0.86	0.68	0.68	0.53	0.78
13	8.3	6.4	9.2	3.4	2.2	1.6	8.3	6.3	8.1	3.4	2.3	1.6	2.45	1.75	1.35	1.19	1.14	0.88	0.90	0.86	0.65	0.81	0.67	0.84
14	6.5	5.1	4.4	3.6	2.5	1.9	6.3	5.1	4.7	3.6	2.3	1.9	2.86	2.19	1.89	1.95	1.70	0.95	1.26	1.01	0.81	0.82	0.70	0.86
15	8.2	6.4	9.9	3.4	2.3	1.8	8.0	6.3	9.3	3.5	2.3	1.7	2.98	2.18	1.76	1.69	1.40	0.78	1.03	0.85	0.66	0.69	0.57	0.83
16	8.1	6.4	7.6	3.3	2.1	1.7	8.3	6.6	10.3	3.4	2.2	1.7	1.73	1.32	1.09	1.21	1.13	0.75	0.81	0.88	0.52	0.38	0.31	0.66
17	7.4	5.7	4.4	3.1	2.1	1.7	7.7	6.0	5.7	3.2	2.1	1.7	2.48	1.77	1.29	1.25	1.19	0.70	0.72	0.76	0.52	0.63	0.49	0.78
18	6.7	5.3	4.0	3.0	2.0	1.7	6.7	5.2	4.0	3.1	2.1	1.7	1.53	1.25	1.01	1.22	1.33	0.90	0.60	0.57	0.63	0.40	0.31	0.69
19	2.7	2.2	2.4	2.3	2.1	2.1	2.6	2.3	2.6	2.4	2.2	2.1	2.06	1.58	1.38	1.43	1.38	0.95	0.67	0.52	0.52	0.56	0.58	0.86
20	4.9	4.4	4.2	3.8	3.1	2.3	4.9	4.3	4.1	3.8	2.3	2.4	2.79	2.50	2.16	2.31	1.81	1.29	1.06	0.81	0.63	0.78	0.87	1.09
Mean	6.5	5.1	5.0	3.2	2.3	1.8	6.4	5.1	5.2	3.2	2.2	1.8	2.44	1.96	1.51	1.49	1.32	0.92	0.86	0.81	0.65	0.68	0.57	0.77

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Table E.6.8 Maximum uplift deformation of 6-storey building in N-S direction (with GWB), mm

No.	Drain-3D												SAPWood											
	Wall 6						Wall 8						Wall 8 - method A						Wall 8 - method B					
	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6	st1	st2	st3	st4	st5	st6
1	6.0	5.0	2.9	3.0	3.1	0.8	5.7	4.1	2.7	3.0	3.0	0.7	2.10	1.62	1.26	1.20	1.06	0.76	0.16	0.55	0.58	1.00	1.92	0.00
2	4.3	3.5	3.0	3.4	3.4	0.9	4.0	3.3	2.8	3.2	3.2	0.9	1.77	1.37	1.18	1.23	1.12	0.86	0.40	0.46	0.60	1.04	1.75	0.00
3	4.9	3.9	3.1	3.3	3.2	0.8	4.8	3.9	3.1	3.3	3.1	0.7	2.10	1.43	1.07	1.12	1.06	0.62	0.64	0.65	0.62	1.07	2.24	0.00
4	5.6	4.5	3.2	3.2	3.1	0.9	5.3	4.0	3.0	3.1	2.9	0.8	1.75	1.22	1.01	0.99	0.95	0.87	0.55	0.57	0.56	1.10	2.07	0.00
5	6.7	15.6	3.5	3.4	3.1	0.6	6.5	13.2	3.3	3.3	3.0	0.6	1.16	0.85	0.68	0.69	0.70	0.57	0.27	0.42	0.29	0.85	1.54	0.00
6	5.7	4.1	2.8	2.8	2.6	0.6	5.4	3.9	2.8	2.8	2.5	0.5	1.63	1.11	0.87	0.81	0.79	0.60	0.32	0.64	0.46	0.65	1.49	0.00
7	5.6	4.6	3.0	3.5	3.4	0.6	5.3	4.0	2.8	3.3	3.2	0.7	0.98	0.70	0.55	0.62	0.70	0.75	0.04	0.14	0.30	0.59	0.56	0.00
8	5.1	3.9	3.1	3.3	3.3	0.9	5.1	3.9	3.1	3.3	3.1	1.0	1.44	1.30	1.04	1.09	1.02	0.77	0.27	0.47	0.37	0.90	1.60	0.00
9	6.3	6.9	3.1	3.0	2.7	0.6	6.0	5.9	3.1	2.9	2.6	0.5	2.15	1.47	1.14	1.12	0.94	0.61	0.67	0.64	0.52	0.80	1.58	0.00
10	6.3	11.0	3.3	3.2	3.0	0.6	6.1	8.8	3.1	3.1	2.9	0.6	1.55	1.17	0.91	1.00	0.77	0.52	0.17	0.40	0.31	0.78	1.14	0.00
11	5.7	7.5	3.6	3.7	3.5	0.5	5.3	5.7	3.3	3.5	3.3	0.7	1.81	1.26	0.96	0.91	0.74	0.53	0.43	0.55	0.54	0.99	1.51	0.00
12	3.5	2.7	2.1	2.4	2.9	0.8	3.5	2.7	2.0	2.4	2.8	0.8	1.44	1.06	0.93	1.18	0.99	0.81	0.21	0.39	0.46	1.03	1.75	0.00
13	6.6	11.8	3.3	3.2	2.9	0.5	6.4	10.1	3.2	3.1	2.9	0.5	1.62	1.15	0.91	0.84	0.80	0.64	0.65	0.72	0.50	0.91	1.72	0.00
14	5.3	4.0	3.2	3.3	3.0	0.7	5.3	4.0	3.2	3.2	2.9	0.6	1.84	1.43	1.23	1.33	1.17	0.66	0.82	0.69	0.64	1.00	1.72	0.00
15	6.4	9.2	3.4	3.3	3.0	0.6	6.4	9.1	3.3	3.3	2.9	0.5	1.96	1.43	1.16	1.14	0.93	0.58	0.70	0.56	0.62	1.01	1.82	0.00
16	6.3	8.9	3.2	3.2	3.1	0.4	6.0	6.9	3.1	3.1	2.9	0.5	1.26	0.97	0.81	0.88	0.85	0.53	0.25	0.45	0.35	0.81	1.52	0.00
17	6.0	4.6	2.9	2.9	2.7	0.5	5.6	4.1	2.8	2.9	2.6	0.4	1.69	1.06	0.86	0.85	0.82	0.59	0.39	0.44	0.41	0.83	1.53	0.00
18	5.9	6.7	3.3	3.4	3.5	0.8	5.6	5.3	3.1	3.3	3.4	0.9	1.01	0.74	0.67	0.82	0.92	0.67	0.00	0.20	0.22	0.47	1.14	0.00
19	2.8	2.5	1.9	2.2	2.2	0.9	2.5	2.2	1.7	2.0	2.1	0.9	1.49	1.15	0.98	1.03	1.01	0.74	0.11	0.16	0.38	0.76	2.06	0.00
20	4.6	3.5	3.0	3.4	3.6	1.0	4.5	3.5	2.8	3.2	3.4	1.1	1.91	1.63	1.48	1.54	1.26	0.98	0.56	0.59	0.57	0.99	1.97	0.00
Mean	5.5	6.2	3.0	3.2	3.1	0.7	5.3	5.4	2.9	3.1	2.9	0.7	1.63	1.21	0.99	1.02	0.93	0.68	0.38	0.48	0.47	0.88	1.63	0.00

Appendix F

Selected time history responses and hysteresis loops of selected shear walls

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Figures F.1 and F.2 show some examples of displacement time history responses (relative to the ground) resulting from the analyses with SAPWood:

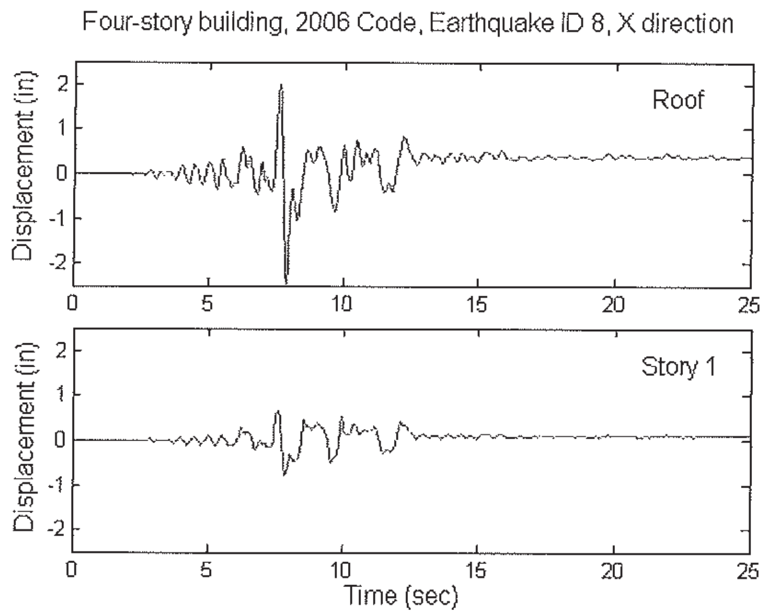

Figure F.1. Displacement time history for the roof level and first storey of the four-storey structure

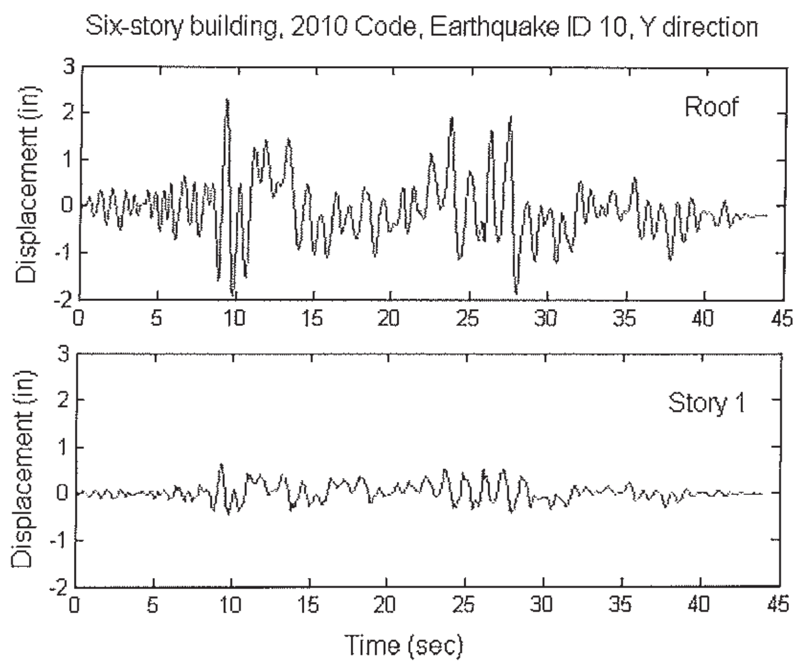

Figure F.2. Displacement time history for the roof level and first storey of the six-storey structure

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