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OVERVIEW OF PART 9 REQUIREMENTS FOR BRACING TO RESIST LATERAL LOADS DUE TO WIND AND EARTHQUAKE

**BOABC 2012 BC Building Code Change Seminar
November - December 2012**



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Why?
Where?
When?
What?
How?



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Why the new requirements?

1. clarify application of code

before: seismic was considered implicitly



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Why the new requirements?

1. clarify application of code
2. reduce risks









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now
explicit and **detailed**
requirements



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Where are the new requirements?



Subsection 9.23.13.

... and several in existing subsections in Section 9.23.



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Where / When do we apply them?

according to

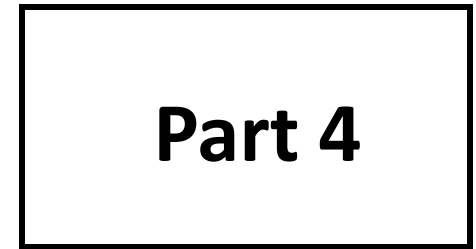
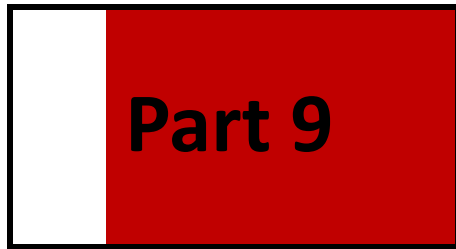
Articles 9.23.13.1. to 9.23.13.3.

structural design requirements in Part 9

seismic

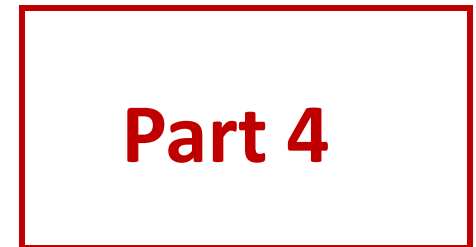
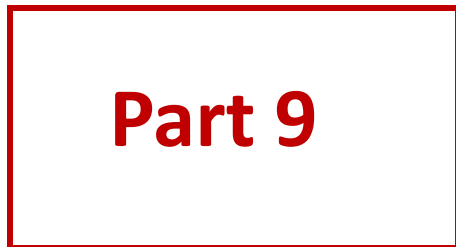
9.4.1.1.

gravity



9.23.13.

Canadian Wood Council
"Engineering Guide for Wood
Frame Construction"



9.23.13.4. to 9.23.13.7.

+ other cross-referenced provisions

Forces

	traditional construction	9.23.13.4. to 9.23.13.7.	Part 4	good engineering practice
Extreme* 9.23.13.3.	✗	✗	✓	optional
High 9.23.13.2.	✗	✓*	optional	optional
Low -Moderate 9.23.13.1.	✓	optional	optional	optional

Wind

$$q_{50} = 1.2$$

$$S_a(0.2) = 1.2^*$$

$$q_{50} = 0.8$$

$$S_a(0.2) = 0.7$$

Earthquake

* different limits for heavy construction

Sa(0.2) values can be found in Div. B Appendix C.

1.2

- Victoria, Langford, Sidney, Tofino, Ucluelet
- Cloverdale, Langley, Ladner, White Rock
- Ladysmith, Duncan, Crofton, Bamfield
- Sooke, Youbou, Surrey, Richmond
- New Westminster, Nanaimo, Port Renfrew
- Abbotsford, Jordan River, Haney
- Vancouver, Burnaby, Mission City
- West Vancouver, North Vancouver
- Sechelt, Tahsis, Parksville
- Qualicum Beach, Gold River
- Port Alberni, Chilliwack, Alberni, Squamish

0.7

- Kent
- Agassiz, Whistler, Powell River
- Courtney, Sandspit
- Kelowna

Sandspit

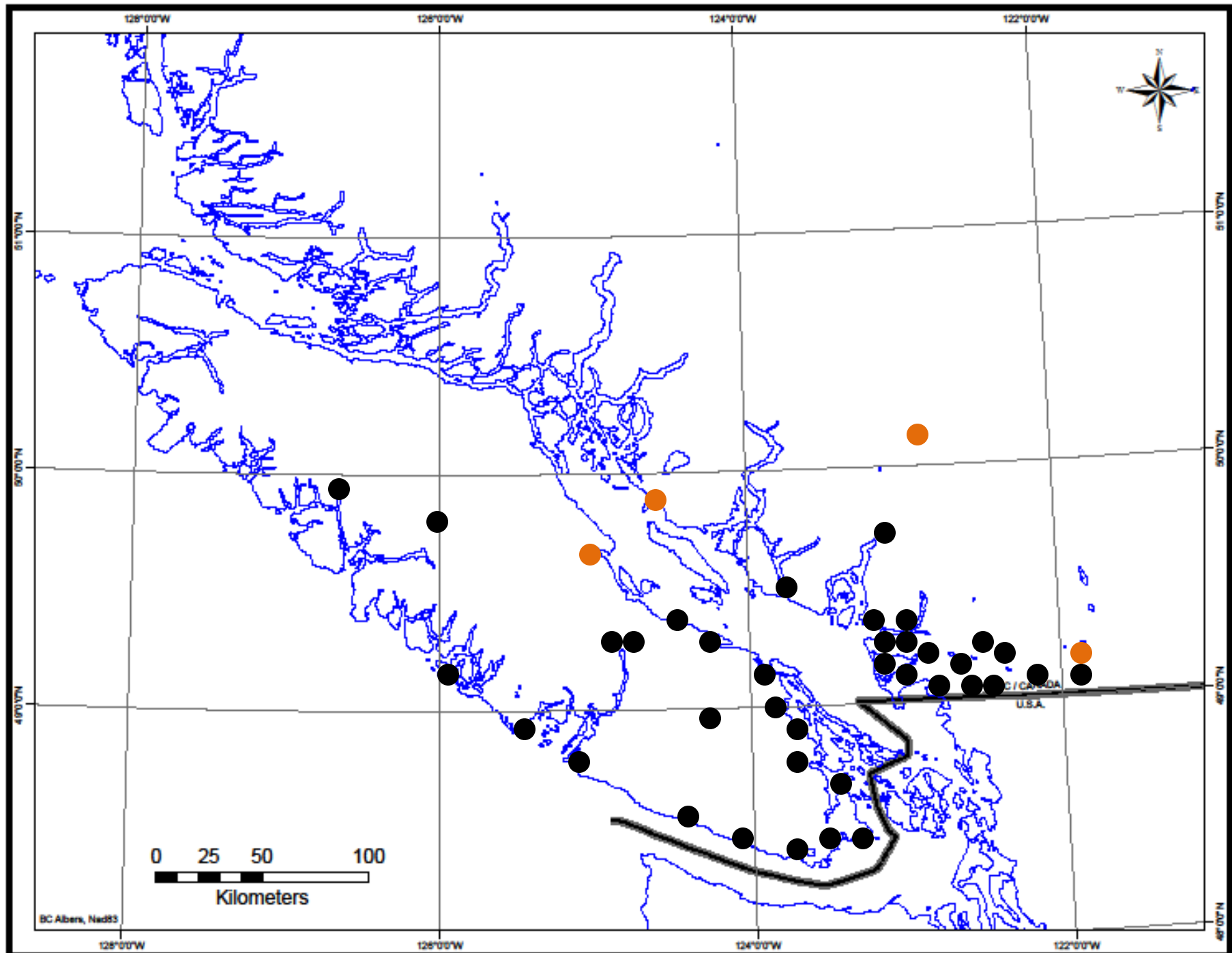
0.8

Earthquake

$S_a(0.2)$

Wind

q_{50}





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What are the new requirements?

- concept
- basic requirements
- exceptions



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Concept

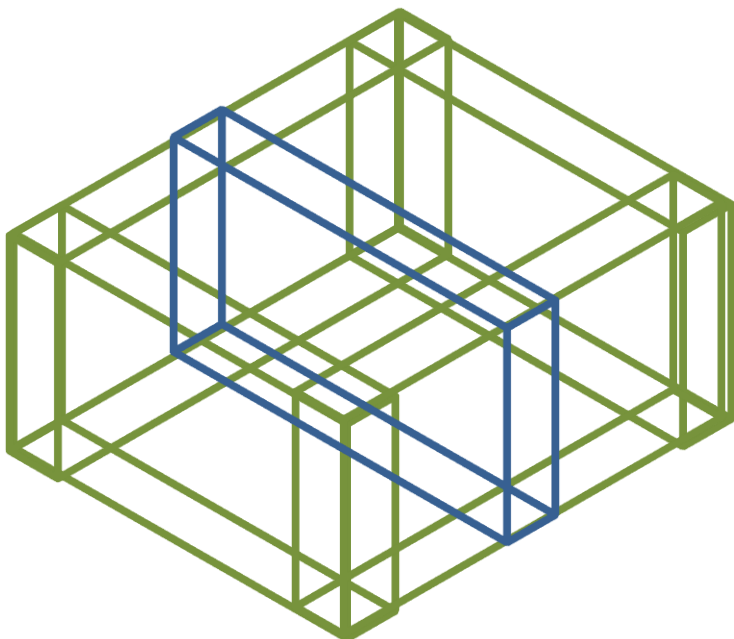
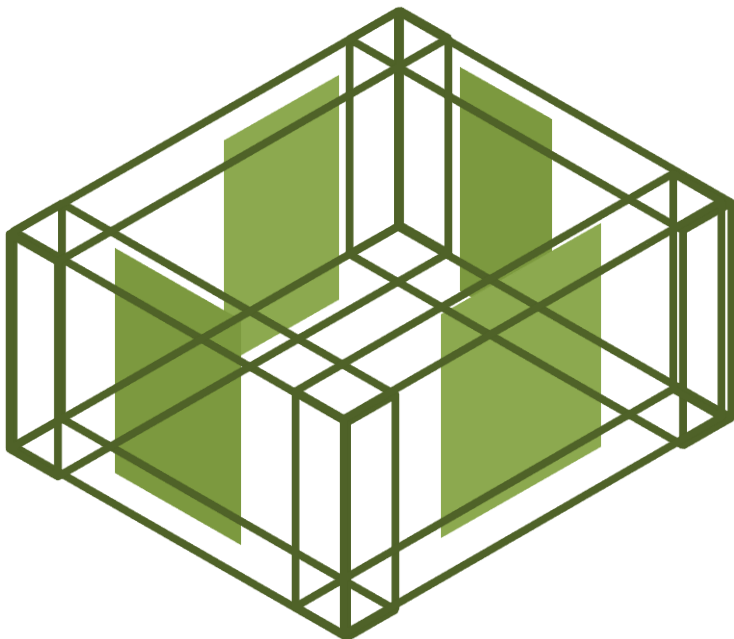
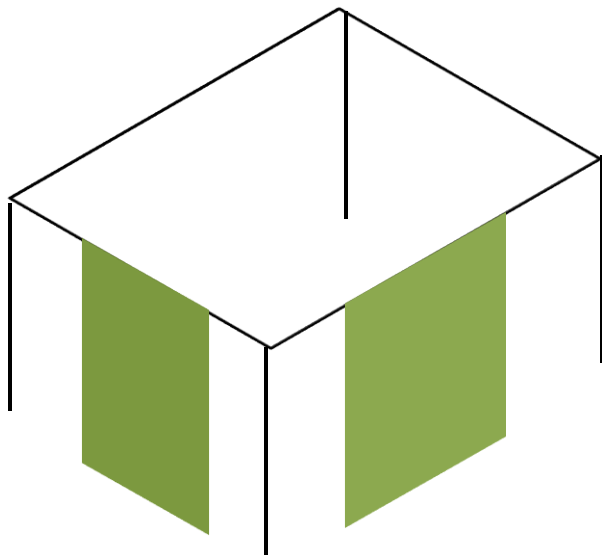
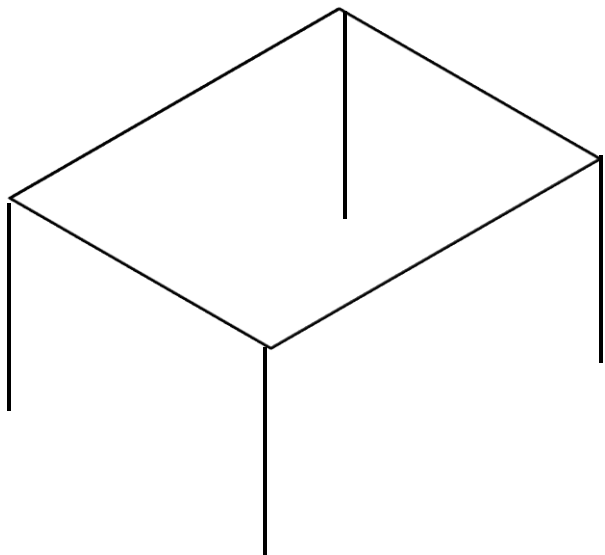


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figure from
HPO Illustrated Guide for
Seismic Design of Houses







New Key Components:

imaginary

braced wall band

real

braced wall panel



Braced Wall Band

an imaginary continuous straight band extending vertically and horizontally through the building or part of the building, within which *braced wall panels* are constructed

Braced Wall Panel

a portion of a wood-frame wall where bracing, sheathing, cladding or interior finish is designed and installed to provide the required resistance to lateral loads due to wind or earthquake

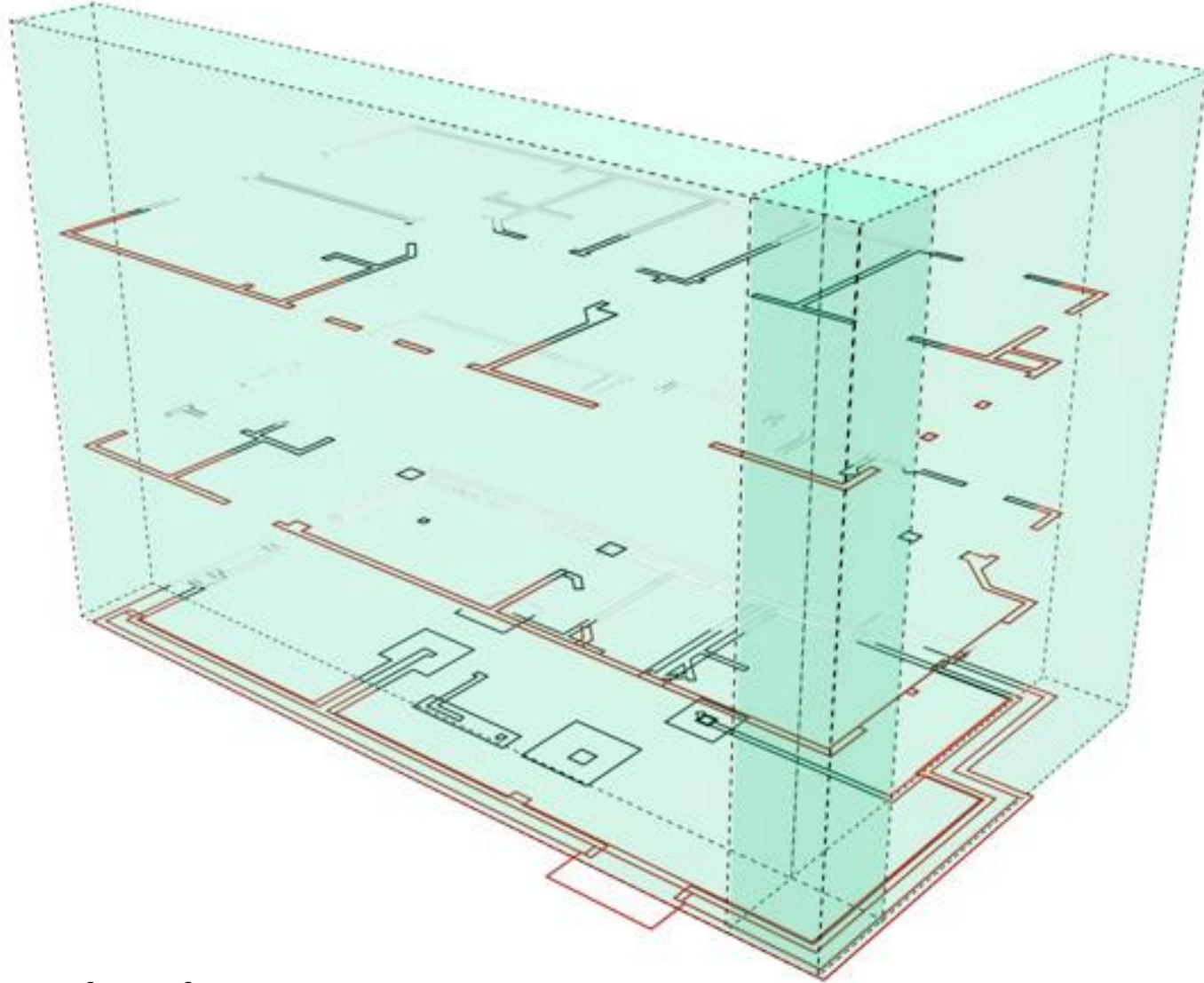


figure from
HPO Illustrated Guide for
Seismic Design of Houses

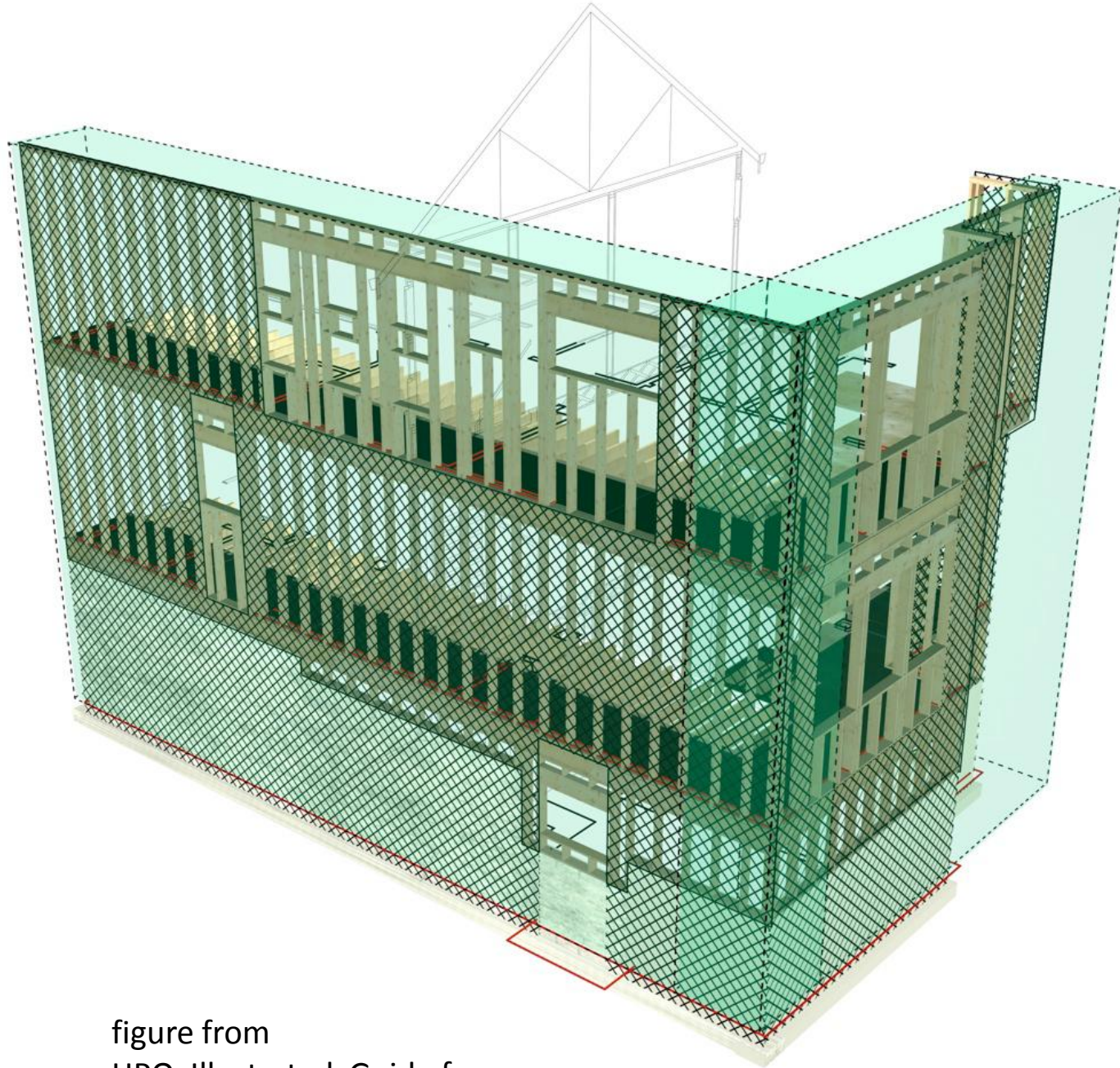


figure from
HPO Illustrated Guide for
Seismic Design of Houses







- main goal:
 - strong stable overall frame

- fundamental requirement:
 - adequate amount of properly constructed walls
 - how to locate and size walls
 - how to build and fasten walls



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Basic

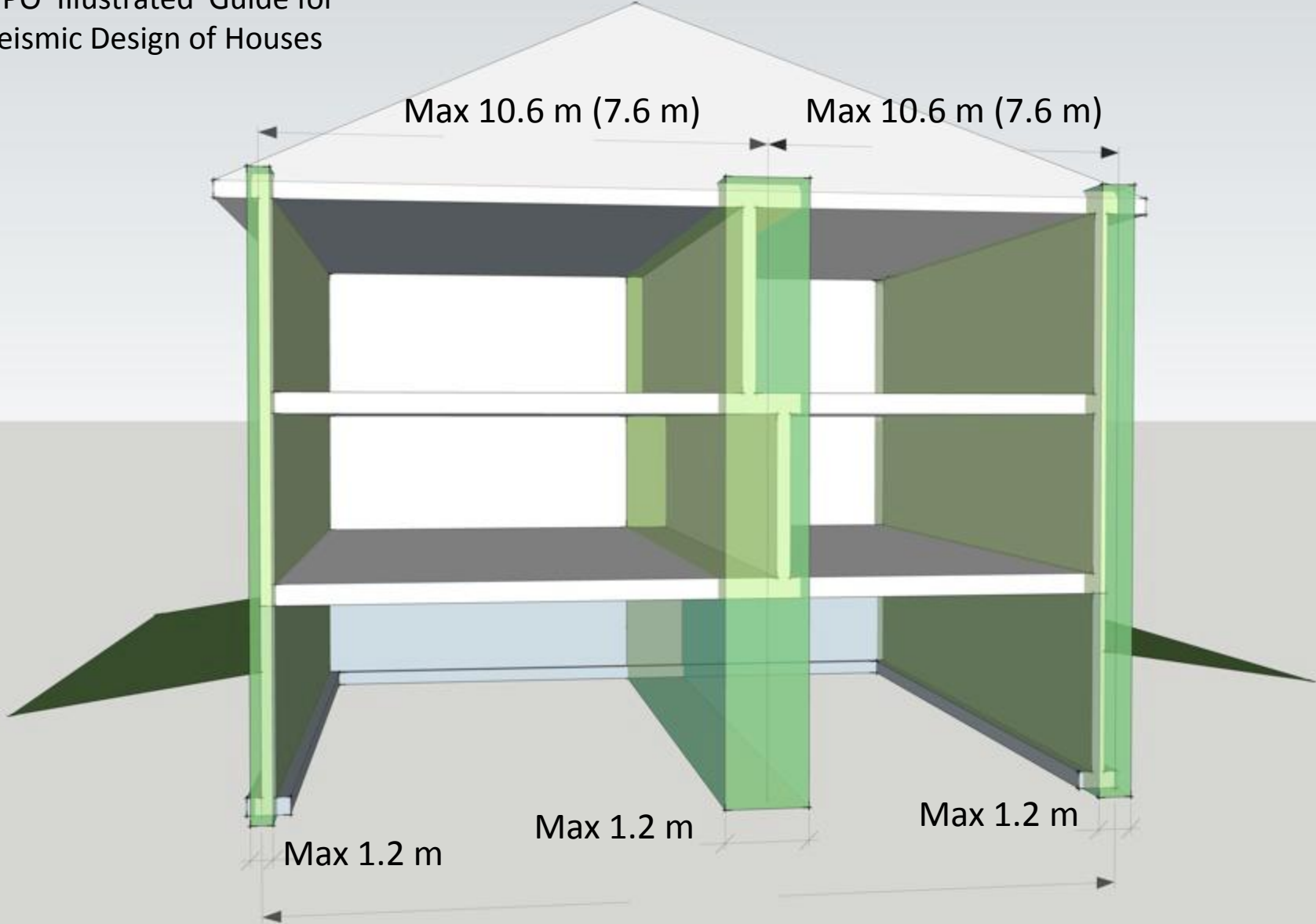
Requirements

9.23.13.4.

Braced Wall Bands shall

- be full storey height
- be $\leq 1.2\text{m}$ wide
- lap at both ends with another BWB
- be aligned with BWBs on storeys above & below
- be spaced, at maximum,
 - ✓ 10.6 m
 - ✓ 7.6m where $1.0 \leq S_a(0.2) \leq 1.2$ [Victoria]

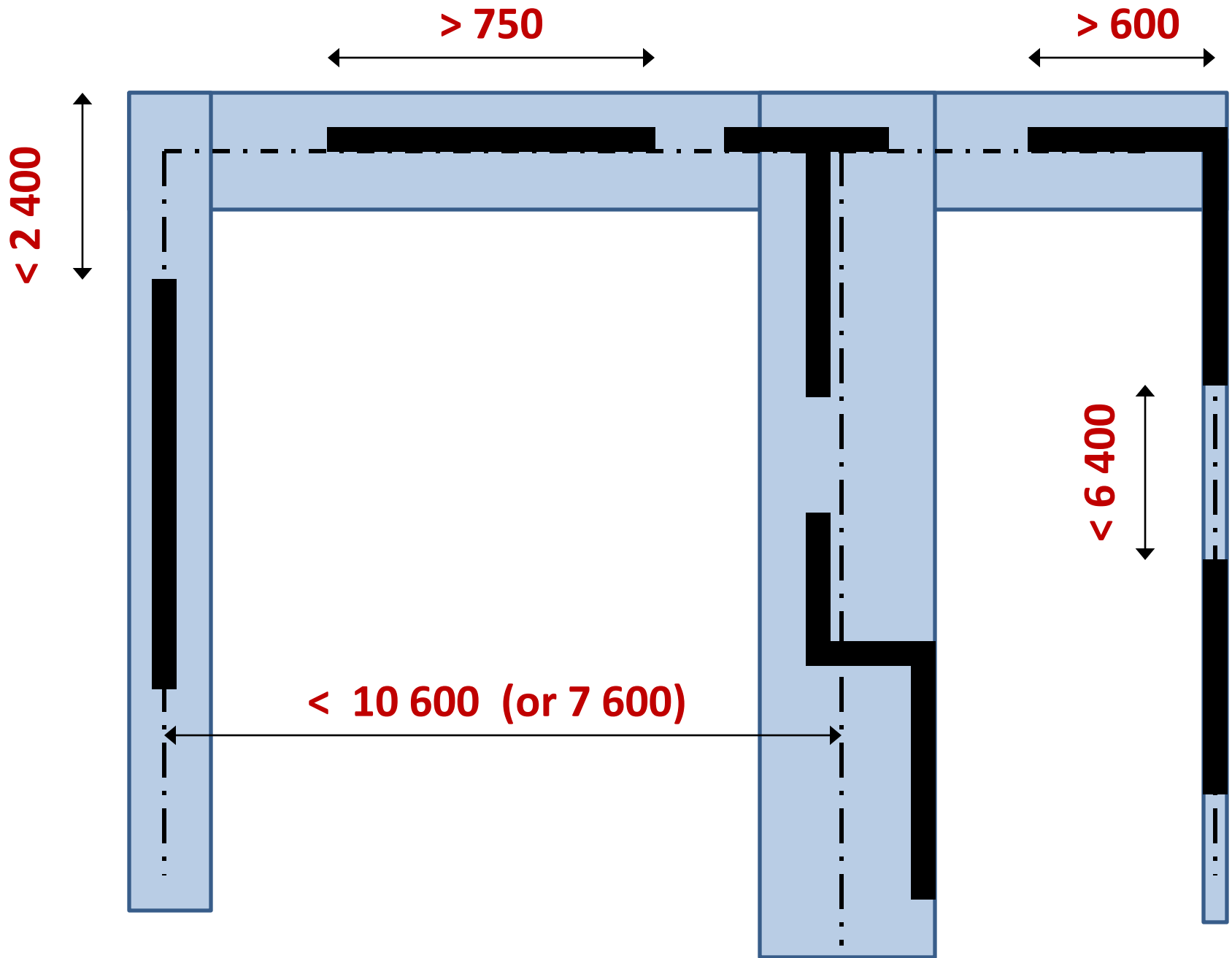
figure from
HPO Illustrated Guide for
Seismic Design of Houses



9.23.13.5.

Braced Wall Panels shall

- be located within BWBs
- extend from top of supporting footing, slab or subfloor to underside of floor ceiling or roof framing above
- conform to limits on
 - ✓ max spacing
 - ✓ max distance from end of BWB
 - ✓ min length
 - ✓ min total length



Minimum Total Length of Braced Wall Panels

in a braced wall band

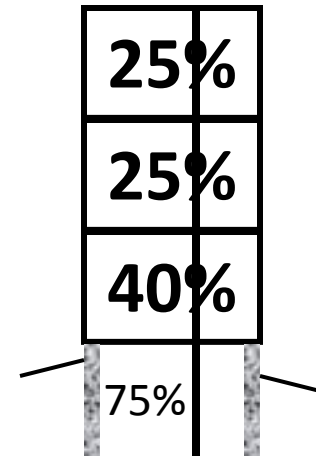
for **light** construction



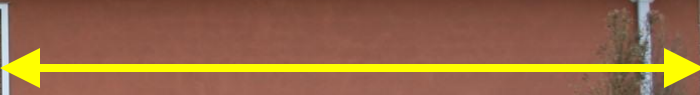
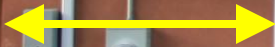
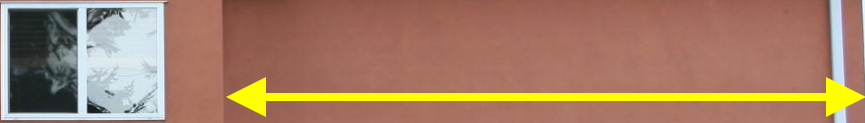
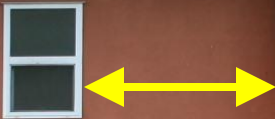
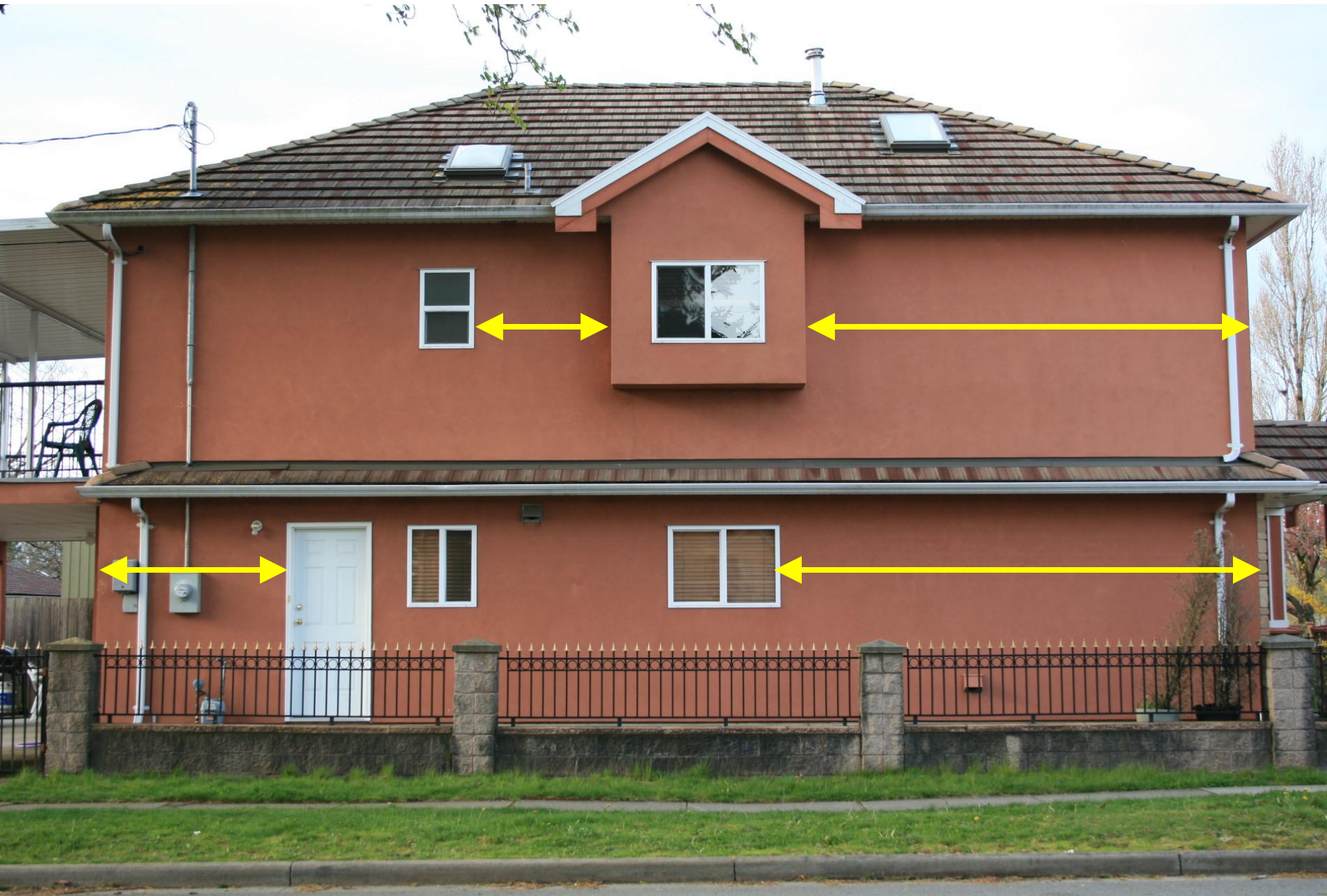
1 storey



2 storeys



3 storeys



9.23.13.6.

Materials in Braced Wall Panels

		Compliance	
cladding	panel-type (plywood, hardboard, OSB)	9.27	Table 9.23.3.4.
sheathing	plywood, OSB, waferboard, or diagonal lumber sheathing	9.23.16.	Table 9.23.13.6.
	fasteners	9.23.3.5	
interior finish	panel-type (gypsum board)	9.29.	Table 9.23.13.6.

Sheathing for BWP

- **Interior** BWPs:

- finished both sides with gypsum board

9.23.13.6.(2)

or

- sheathed both sides with wood-based material

or

- sheathed one side only but with

9.23.13.6.(3)

- plywood, OSB or waferboard only

- fastener spacing reduced by half

- **Exterior** BWPs:

9.23.13.6.(5)

- interior gypsum board not considered acceptable

Additional Requirement for BWP

9.23.13.6.(4)

When any one BWP is required to be of a wood-based material,

all other required BWPs in that BWB shall be of wood-based material.

Fasteners for Sheathing

9.23.3.5.

in required BWPs

		Minimum Length (mm)			Maximum Spacing (mm)
		Nails	Screws	Staples	
Plywood, OSB or waferboard	$t \leq 20$ mm	63	51	63	150 -- edges
	$20 \text{ mm} < t \leq 25$ mm	63	57	n/a	300 -- intermediate supports

➤ longer minimum lengths

Nailing of Framing

9.23.3.4.

	Minimum Length (mm)	Maximum Spacing or Minimum Number
	Nails	
required Braced Wall Panels to framing above and below (interior walls)	82	150 mm o.c.
bottom wall plate or sole plate in required BWPs to floor joists, rim joists or blocking (exterior walls)		
rim joist, blocking to sill plate or top wall plate (supporting <u>walls with</u> required BWPs)		

Anchorage of Building Frames

9.23.6.1.

- **minimum 2 anchor bolts per BWP**
- **located within 500 mm of end of foundation**
- > **15.9** mm ϕ @ max **2400** mm o.c.
> 12.7 mm ϕ @ max **1700** mm o.c.





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Exceptions

9.23.13.5.(3)

porches & sun rooms

- $\leq 3.5\text{m}$ projection
- 1:2 plan dimensions
- no floor above
- integral with main roof or fastened to wall



➤ BWP's not required

attached garages

- $\leq 7.6\text{m}$ between front and back
- $\geq 50\%$ of back wall is BWPs
- $\geq 25\%$ of side walls is BWPs
- ≤ 1 floor above

9.23.13.5.(4) and (5)



bigger openings in exterior walls

9.23.13.7.(6) and (7)

25%

25%

40%

- additional interior braced wall required
- reduced total length in upper storeys (soft storey)

reduced to
min. 25%

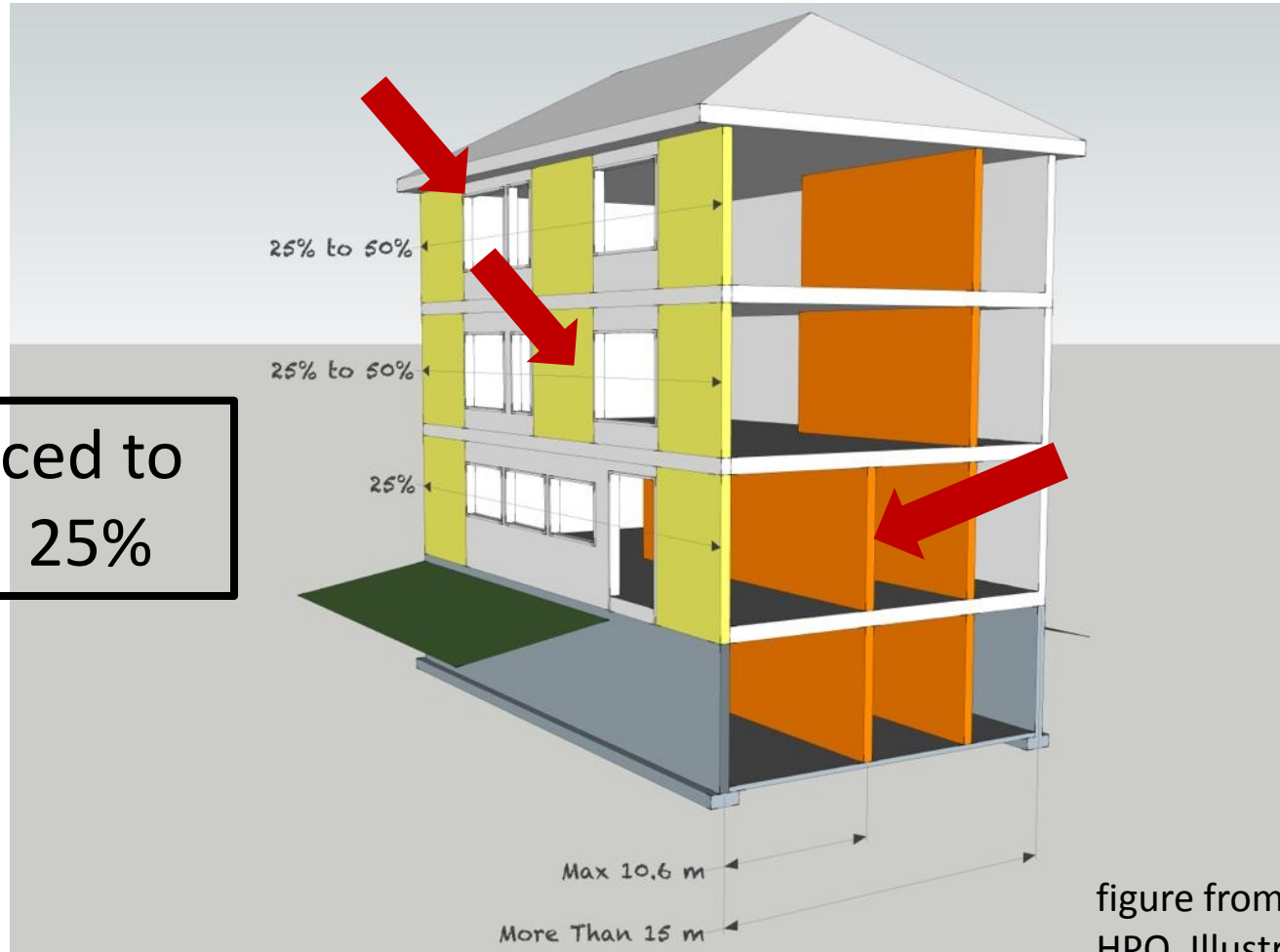


figure from
HPO Illustrated Guide for
Seismic Design of Houses

full-height basements

9.23.13.5.(2)

➤ stop BWPs at ground floor

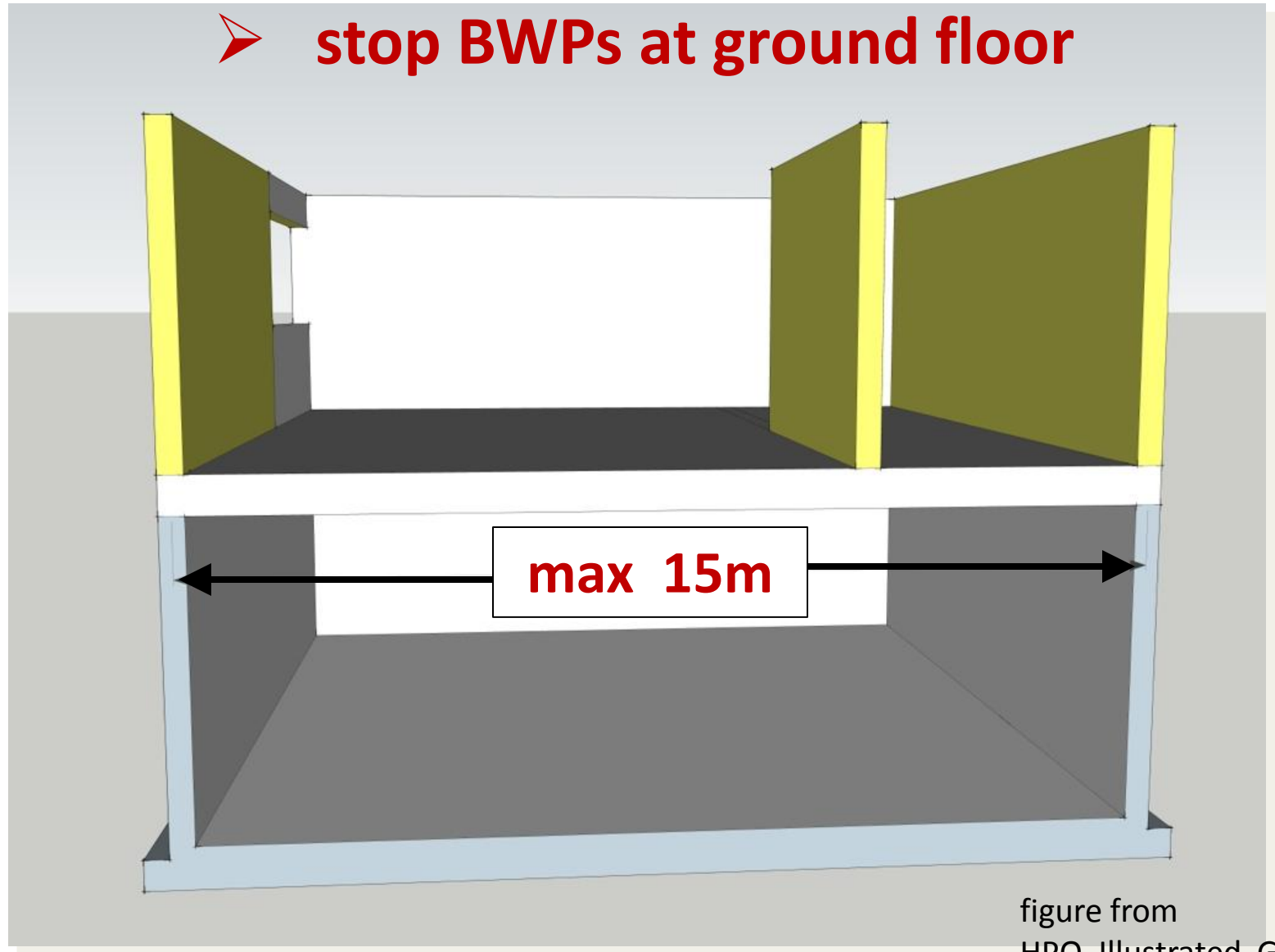


figure from
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setbacks



setbacks

9.23.13.7.(1), (2), (3)

- additional requirements for adjacent interior braced wall band
- sheathed floor and roof at setback
- additional fastening in perpendicular walls

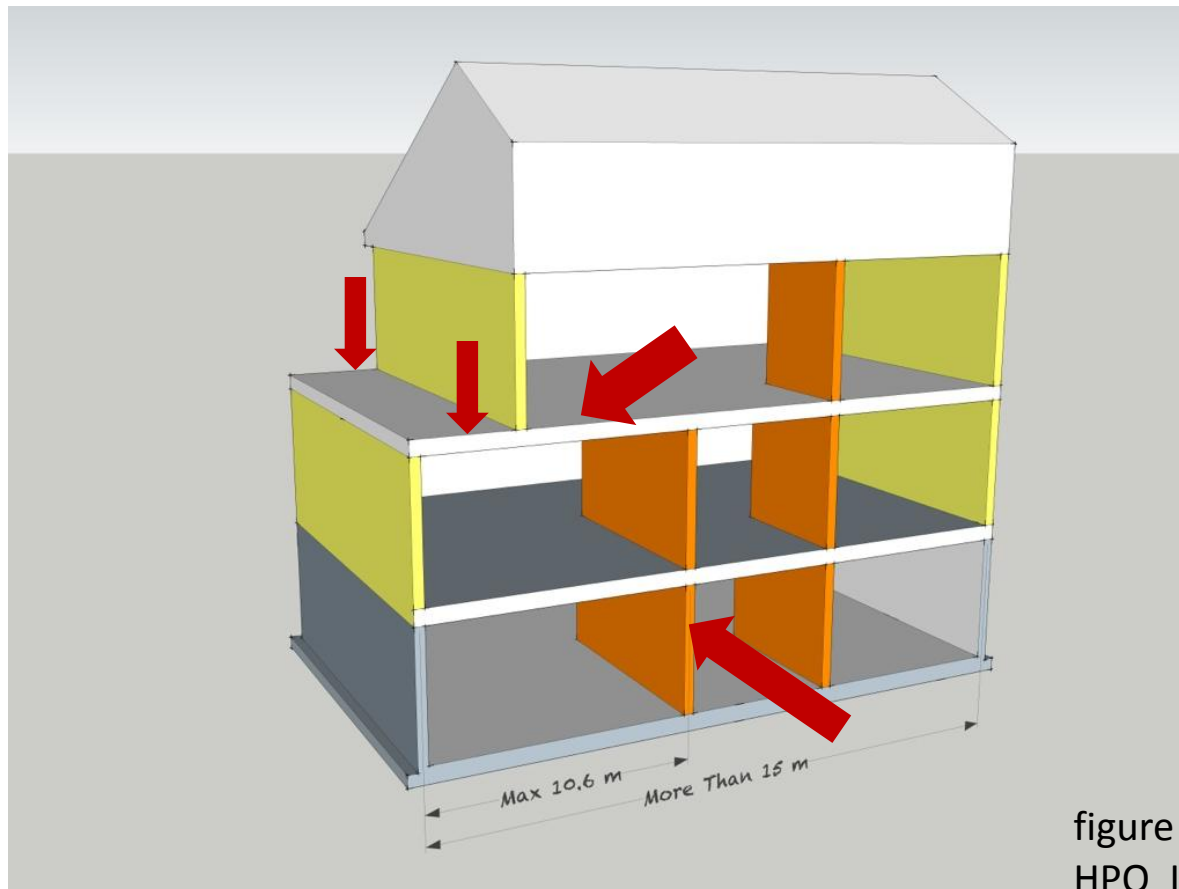








figure from
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Seismic Design of Houses

heavy construction



heavy construction

Forces

	traditional construction	9.23.13.4. to 9.23.13.7.	Part 4	good engineering practice
Extreme 9.23.13.3.				optional
High 9.23.13.2.			optional	optional
Low -Moderate 9.23.13.1.		optional	optional	optional

$$S_a(0.2) = 1.1$$

$$S_a(0.2) = 0.7$$

heavy construction

1.1

- Victoria, Langford, Sidney, Tofino, Ucluelet
- Cloverdale, Langley, Ladner, White Rock
- Ladysmith, Duncan, Crofton, Bamfield
- Sooke, Youbou, Surrey, Richmond
- New Westminster, Nanaimo, Port Renfrew
- Abbotsford, Jordan River, Haney
- Vancouver, Burnaby, Mission City
- West Vancouver, North Vancouver
- Sechelt, Tahsis, Parksville
- Qualicum Beach, Gold River
- Port Alberni, Chilliwack, Alberni, Squamish

0.7

- Kent
- Agassiz, Whistler, Powell River
- Courtney, Sandspit
- Kelowna

Sandspit

0.8

Wind

Earthquake

$S_a(0.2)$

q_{50}

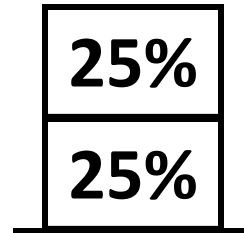
Minimum Total Length of Braced Wall Panels

in a braced wall band

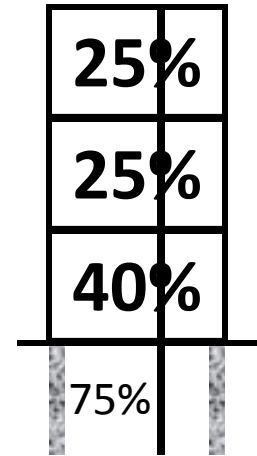
**Light
Construction**



1 storey

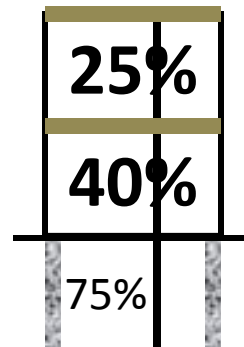
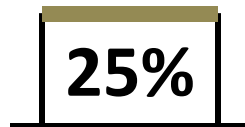


2 storeys



3 storeys

**Heavy
Construction**





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How to check for the requirements?

from whole to detail



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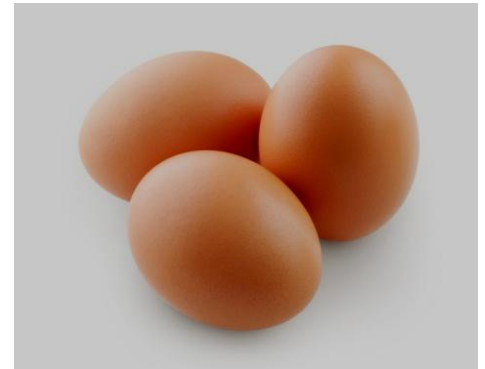
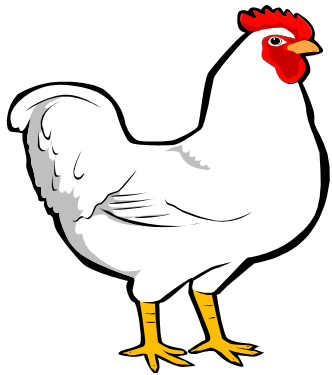


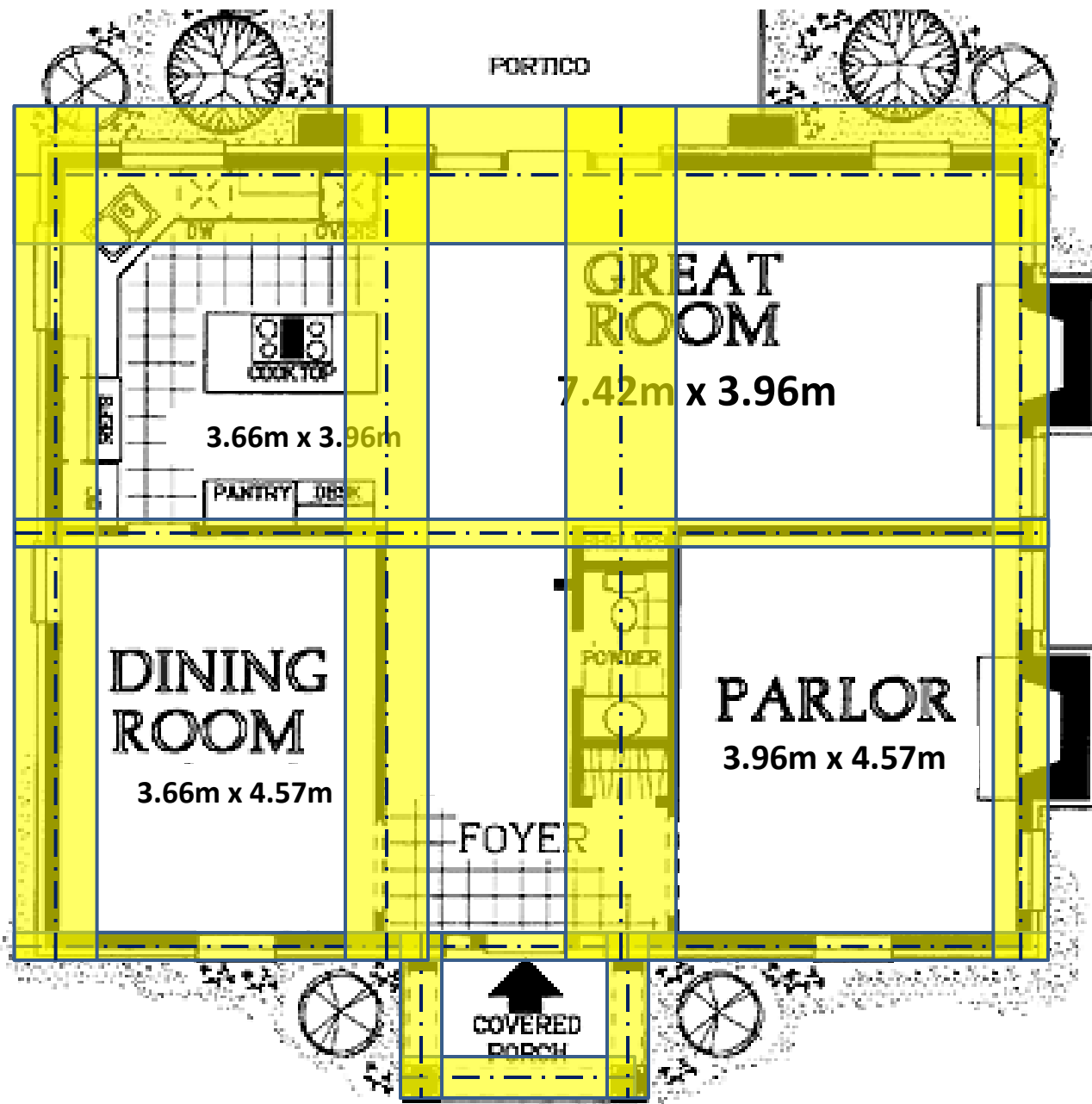
braced wall band

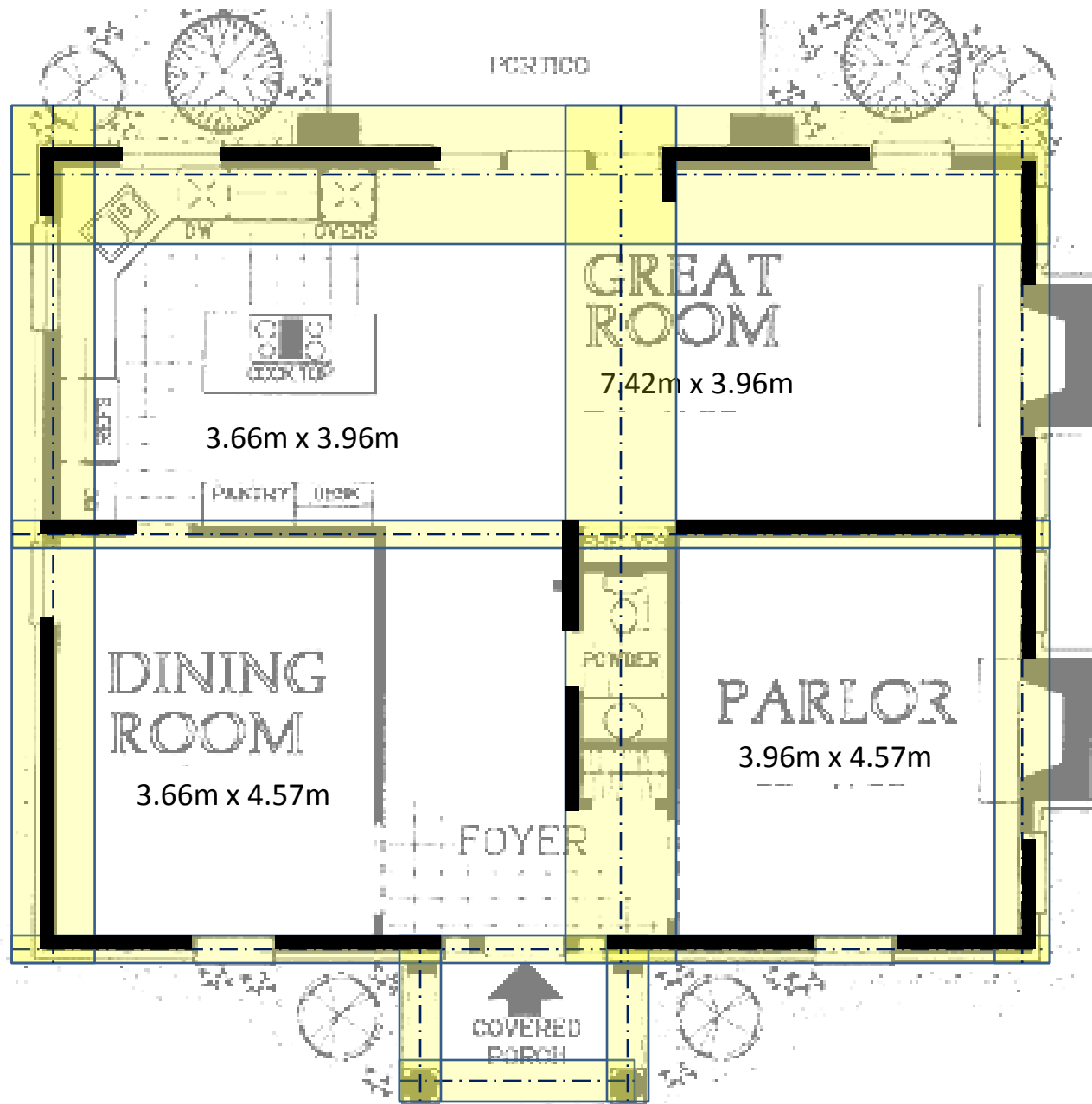
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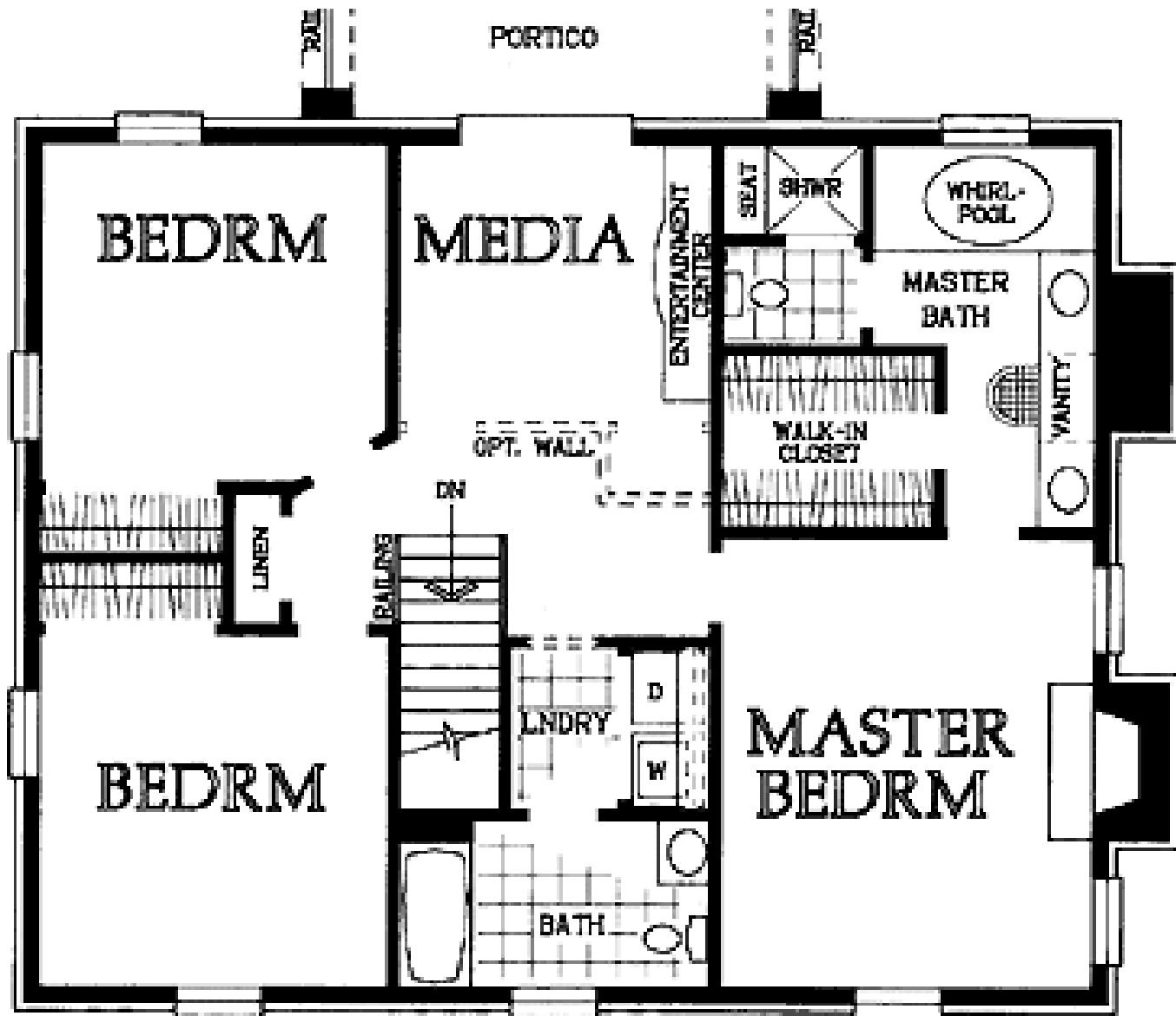
braced wall panel

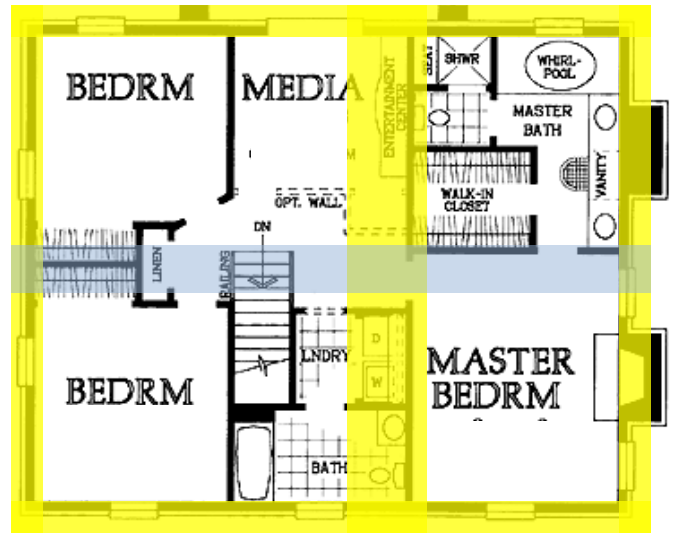
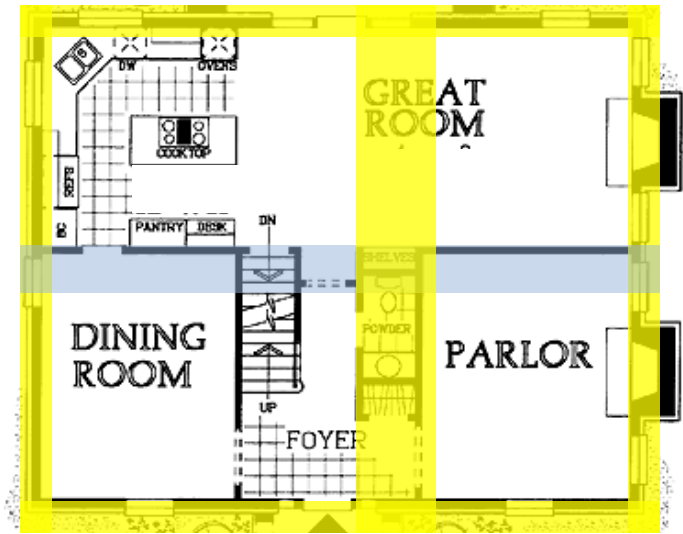
first?







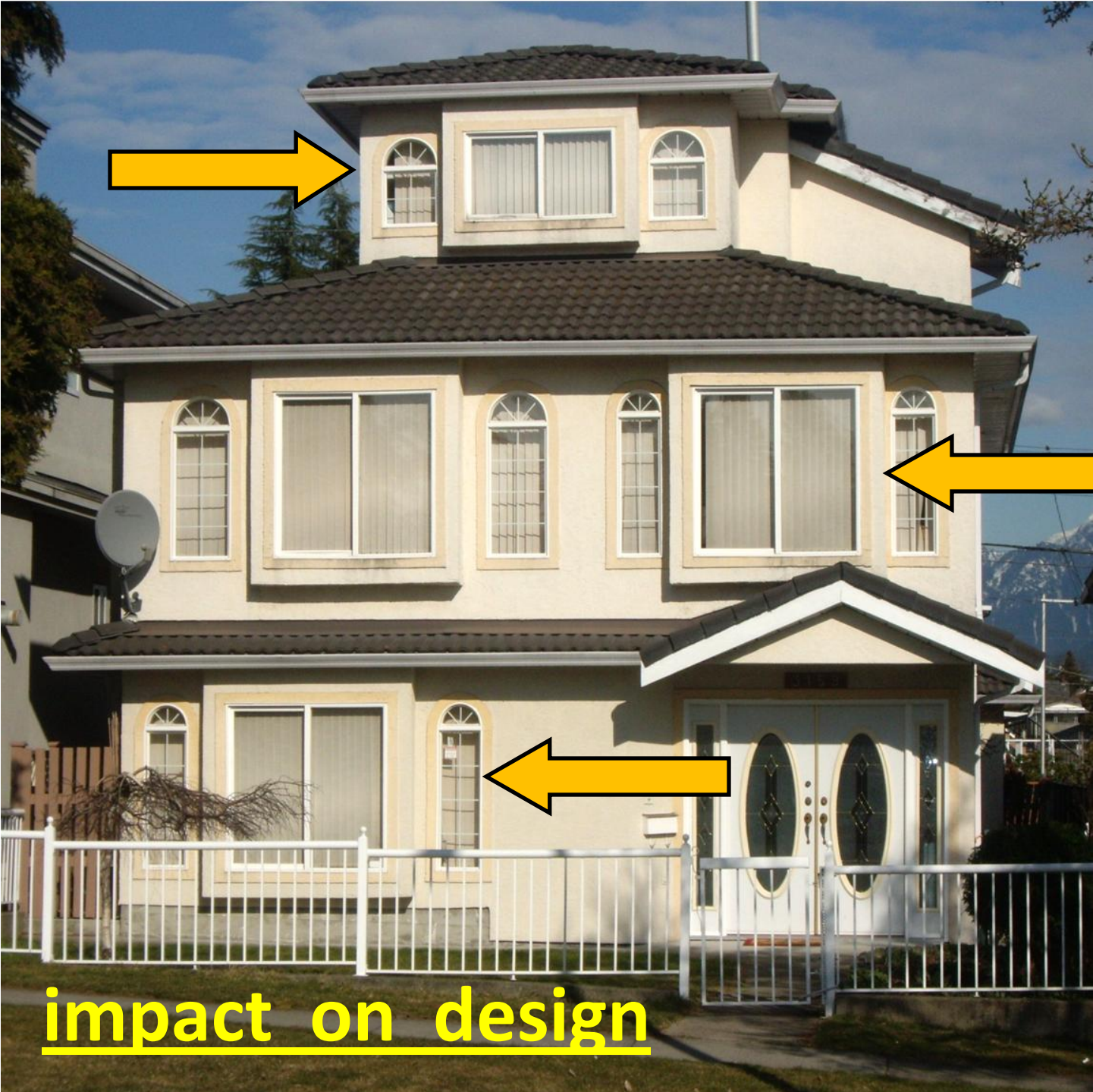






consider exceptions

- set all braced wall bands
- set all braced wall panels
- check min total lengths of panels (ie. 25%, 40%, 75%)
in each braced wall band



impact on design



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- ✓ materials in braced wall panels
- ✓ fastening of sheathing in braced wall panels
- ✓ nailing of framing
- ✓ anchorage of frame and braced wall panels



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Thank You