



December 2014 – Building Code Changes Dealing With Energy Efficiency

Effective December 19, 2014 changes are being made to the 2012 British Columbia Building Code. The revisions are substantially related to 9.36 Energy Efficiency (and relocation of Secondary Suites to 9.37), 9.32 Ventilation, and 9.13 Radon provisions. The included documents are not intended to address all revisions of the Code, but as an overview and guide to the changes.

The 2012 BCBC must be referred to for actual Code requirements.



2012 BC Building Code Changes – Energy Efficiency

Effective December 19, 2014 changes are being made to the 2012 British Columbia Building Code. The revisions are substantially related to 9.36 Energy Efficiency (and relocation of Secondary Suites to 9.37), 9.32 Ventilation, and 9.13 Radon provisions. This bulletin is not intended to address all revisions of the Code, but an overview. The 2012 BCBC must be referred to for actual Code requirements. In general, the changes include the following, but are not limited to:

9.13 Radon

- Provisions have been added to require radon rough-in to extend to outside the building envelope;
- Terminations reflect those for plumbing vents; and
- Labelling of the pipe at 1.2m intervals and changes in direction.

9.32 Ventilation

- The principal exhaust fan (PEF) must be designed to run continuously;
- The sizing of the PEF is based on square footage and number of bedrooms;
- The PEF must be provided with a switch and be labelled;
- Where a combined fan is provided (ie. bathroom fan as PEF), two stage operation is required;
- Exhaust only systems are no longer permitted and supply air provisions must be made;
- Energy efficiency criteria has been provided for mechanical equipment;

9.36 Energy Efficiency

- This Code section has been added as 9.36 to harmonize with the NBC, and relocates Secondary Suites to 9.37;
- Nominal insulation values have been replaced with effective insulation values and requires the calculation for each building assembly;
- Provisions have been made for limited trade-offs for required insulation values;
- A Performance option for compliance is available through Energy Modelling by qualified persons;
- Benefits for the installation of an HRV have been provided;
- Criteria has been provided for the continuity of insulation;
- Requirements for continuity of insulation values at plumbing and HVAC locations;
- Additional criteria has been added for the lapping, sealing, and support of the air barrier;
- Requirements for the insulation and sealing of piping and ductwork outside the building envelope have been added; and
- Requirements for the insulation of recirculation lines, and piping within 2m of the service water heater.

This does not cover the entirety or specifics of all Code errata and revisions. 2012 BC Building Code errata and revisions may be found at www.bccodes.ca. In addition, changes can be found in the Homeowner Protection Office “Illustrated Guide – Energy Efficiency Requirements for Houses in British Columbia” specific to Climate Zone 5 to 7A North Vancouver Island and Interior, which includes Kamloops (Zone 5). A more detailed summary of Code changes is available through the Homeowner Protection Office at www.hpo.ca.

Plan / Submission Requirements

As a result of the Code changes additional information will be required at the building permit application stage to ensure compliance with new 2012 BCBC requirements. This information should be provided on the building permit drawings. You may wish to use the 9.36 Energy Efficiency Design Worksheet. The following must be specified on the submitted plans:

- The plans are in compliance with the 2012 British Columbia Building Code;
- The plans are designed for Climatic Zone 5 or 6 (applicable to Kamloops and the TNRD);
- The compliance path:
 - Prescriptive;
 - Prescriptive with Trade-offs – including calculations; or
 - Performance – including energy modelling calculations;
- The proposed RSI values for specific construction elements as follows (without HRV):
 - Ceiling below attic assemblies (minimum RSI 8.67);
 - Cathedral ceiling and flat roof assemblies (minimum RSI 4.67);
 - Exterior wall assemblies (minimum RSI 3.08);
 - Floors over unheated space assemblies (minimum RSI 4.67);
 - Rim joist assemblies;
 - Garage/dwelling wall assemblies (minimum RSI 2.92);
 - Garage/dwelling floor assemblies (minimum RSI 4.51);
 - Foundation wall assemblies (minimum RSI 2.98); and
 - Floors on ground (slab on grade) assemblies including:
 - Below frost line;
 - Above frost line; and
 - Heated
 - Windows and Doors Zone 5 (maximum U-value 1.80)
 - Windows and Doors Zone 6 (maximum U-value 1.60)
 - Skylights Zone 5 (maximum U-value 2.90)
 - Skylights Zone 6 (maximum U-value 2.70)
- Identification and calculations for any trade-off proposals;
- Identification of air barrier location;
- Location and specifications for any rigid insulation in assemblies;
- Insulation details at plumbing and ductwork adjacent to insulated assemblies;

In order to facilitate review of building permit applications, the submitted drawings must accurately indicate the proposed construction. Cross sections and details must clearly show enough information to show compliance with the 2012 BCBC.

9.36 Energy Efficiency Design Worksheet

This supplemental form is to be completed and submitted with building permit applications where design drawings do not indicate specific design criteria.

	YES	NO
Design complies with 2012 BC Building Code		
Design complies with requirements for Climate Zone 5 or 6		
Heat Recovery Ventilator (HRV) to be provided		
Compliance Path		
Prescriptive		
Prescriptive with Trade-offs – calculations included		
Performance – energy modelling calculations included		

Construction Assemblies

Roof Assembly – ceiling below attic		
	Component	RSI
1		
2		
3		
4		
5		
6		
7		
8		
	Required RSI	Proposed RSI
	Effective Value (without HRV)	8.67
	Effective Value (with HRV Zone 5)	6.91
	Effective Value (with HRV Zone 6)	8.67

Roof Assembly – cathedral ceiling and flat roof assembly		
	Component	RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
	Required RSI	Proposed RSI
	Effective Value (with or without HRV)	4.67

Exterior Wall Assembly		
	Component	RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
	Effective Value (without HRV)	3.08
	Effective Value (with HRV)	2.97
		Proposed RSI

Additional Exterior Wall Assembly (if applicable ie different cladding)		
	Component	RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
	Effective Value (without HRV)	3.08
	Effective Value (with HRV)	2.97
		Proposed RSI

Floors over Unheated Space Assembly		
	Component	RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
	Effective Value (with or without HRV)	4.67
		Proposed RSI

Garage / Dwelling Wall Assembly		
Component		RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
Effective Value (3.08 - 0.16) without HRV		2.92
Effective Value (2.97 - 0.16) with HRV		2.81

Garage / Dwelling Floor Assembly		
Component		RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
Effective Value (4.67 - 0.16) without HRV		4.51
Effective Value (4.56 - 0.16) with HRV		4.40

Foundation Wall Assembly		
Component		RSI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
		Required RSI
Effective Value (with or without HRV)		2.98

Thermal Resistance (RSI) Values of Common Building Materials
See Table A-9.36.2.4.(1)D for a complete list of building materials

Building Element	RSI
Exterior Air Film (n/a to foundations)	0.03
Interior Air Film - ceiling	0.11
Interior Air Film - floor	0.16
Interior Air Film - walls	0.12
13mm air cavity - walls	0.16
21mm Stucco	0.019
Hollow backed vinyl siding over sheathing	0.11
200mm 13mm thick wood bevel siding	0.14
Hardiplank (fiber-cement) siding	0.026
Stone	0.0004/mm
Asphalt roll roofing	0.03
Asphalt shingles	0.08
Built up roofing	0.06
3/8 plywood	0.083
7/16 plywood	0.096
1/2 plywood	0.109
3/8 OSB	0.093
7/16 OSB	0.108
1/2 OSB	0.123
Permeable felt	0.011
Seal, plastic film	0.00
R12	2.11
R14	2.46
R19 (R20 compressed)	3.34
R22	3.87
R24	4.23
R28	4.93
R40	7.04
EPS (expanded polystyrene) Type 1 - 25mm	0.65
EPS (expanded polystyrene) Type 2 - 25mm	0.71
XPS (extruded polystyrene) - 25mm	0.88
Loose fill cellulose	0.025/mm
Loose fill glass fibre for attics	0.01875/mm
Concrete	0.0004/mm
Structural framing SPF (0.0085/mm) 2x4	0.76
Structural framing SPF (0.0085/mm) 2x6	1.19
Structural framing SPF (0.0085/mm) 2x8	1.56
Structural framing SPF (0.0085/mm) 2x10	2.00
GWB (0.0061/mm) 1/2"	0.076
Plywood	0.0087/mm
Carpet and fibrous pad	0.370
Cork tile - 3.2mm	0.049
Tile (linoleum, vinyl, rubber)	0.009

R value = RSI x 5.678

Framing and Cavity Percentages

See Table A-9.36.2.4.(1)A for a complete list of typical wood frame assemblies

Ceilings with typical trusses 24" o/c	11% framing 89% cavity
Roofs with lumber rafters 24" o/c	10% framing 90% cavity
Wood frame walls 16" o/c	23% framing 77% cavity
Wood frame walls 24" o/c	20% framing 80% cavity

Effective RSI Values for Cavities

See Table A-9.36.2.6.(1)B for a complete list of framing/cavity values

2x4 16" o/c R12	1.49	2x6 16" o/c R19	2.36
2x4 16" o/c R14	1.62	2x6 16" o/c R22	2.55
2x4 24" o/c R12	1.55	2x6 24" o/c R19	2.45
2x4 24" o/c R14	1.70	2x6 24" o/c R22	2.67

2012 BC Building Code Changes

Effective Thermal Resistance of Common Wall Assemblies

RED values do not comply with minimum code requirements

GREEN values do comply with minimum code requirements

2x6 framing filled with R22 batt @ 16" o.c.									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x6 framing filled with R22 batt @ 16 " o.c.	2.55	14.50	2.55	14.50	2.55	14.50	2.55	14.50
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.00	17.06	2.92	16.60	3.03	17.23	2.91	16.54
With HRV		3.00	17.06	2.92	16.60	3.03	17.23	2.91	16.54

2x6 framing filled with R22 batt @ 19.2" o.c.									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x6 framing filled with R22 batt @ 19.2 " o.c.	2.61	14.82	2.61	14.82	2.61	14.82	2.61	14.82
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.06	17.38	2.98	16.92	3.09	17.55	2.97	16.87
With HRV		3.06	17.38	2.98	16.92	3.09	17.55	2.97	16.87

2x6 framing filled with R22 batt @ 24" o.c.									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x6 framing filled with R22 batt @ 24 " o.c.	2.67	15.18	2.67	15.18	2.67	15.18	2.67	15.18
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.12	17.74	3.04	17.28	3.15	17.91	3.03	17.23
With HRV		3.12	17.74	3.04	17.28	3.15	17.91	3.03	17.23

Minimum effective RSI without HRV installed - 3.08

Minimum effective RSI with HRV installed - 2.97

2012 BC Building Code Changes

Effective Thermal Resistance of Common Wall Assemblies

RED values do not comply with minimum code requirements

GREEN values do comply with minimum code requirements

2x4 framing filled with R12 batt @ 16" o.c. clad with R5 exterior insulation									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x4 framing filled with R12 batt @ 16" o.c.	1.49	8.47	1.49	8.47	1.49	8.47	1.49	8.47
5a	With R5 sheet on the exterior	0.88	5.00	0.88	5.00	0.88	5.00	0.88	5.00
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		2.82	16.03	2.74	15.57	2.85	16.20	2.73	15.52
With HRV		2.82	16.03	2.74	15.57	2.85	16.20	2.73	15.52

2x6 framing filled with R20 batt @ 16" o.c. clad with R5 exterior insulation									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x6 framing filled with R20 batt @ 16" o.c.	2.36	13.42	2.36	13.42	2.36	13.42	2.36	13.42
5a	With R5 sheet on the exterior	0.88	5.00	0.88	5.00	0.88	5.00	0.88	5.00
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.69	20.98	3.61	20.52	3.72	21.15	3.60	20.46
With HRV		3.69	20.98	3.61	20.52	3.72	21.15	3.60	20.46

2x6 framing filled with R20 batt @ 24" o.c. clad with R5 exterior insulation									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x6 framing filled with R20 batt @ 24" o.c.	2.45	13.93	2.45	13.93	2.45	13.93	2.45	13.93
5a	With R5 sheet on the exterior	0.88	5.00	0.88	5.00	0.88	5.00	0.88	5.00
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.78	21.49	3.70	21.03	3.81	21.66	3.69	20.98
With HRV		3.78	21.49	3.70	21.03	3.81	21.66	3.69	20.98

Minimum effective RSI without HRV installed - 3.08

Minimum effective RSI with HRV installed - 2.97

2012 BC Building Code Changes

Effective Thermal Resistance of Common Wall Assemblies

RED values do not comply with minimum code requirements

GREEN values do comply with minimum code requirements

2x4 framing filled with R12 batt @ 16" o.c. clad with R7.5 exterior insulation									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	0.03	0.17
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	0.02	0.11
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	0.11	0.63
5	2x4 framing filled with R12 batt @ 16" o.c.	1.49	8.47	1.49	8.47	1.49	8.47	1.49	8.47
5a	With R7.5 sheet on the exterior	1.32	7.50	1.32	7.50	1.32	7.50	1.32	7.50
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	0.08	0.45
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	0.12	0.68
Effective RSI / R Value of Entire Assembly		3.26	18.53	3.18	18.08	3.29	18.70	3.17	18.02
With HRV		3.26	18.53	3.18	18.08	3.29	18.70	3.17	18.02

2x6 framing filled with R22 batt @ 16" o.c. and exterior strapping									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	na	na
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	na	na
2a	Strapping	0.16	0.91	0.16	0.91	0.16	0.91	na	na
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	na	na
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	na	na
5	2x6 framing filled with R22 batt @ 16" o.c.	2.55	14.50	2.55	14.50	2.55	14.50	na	na
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	na	na
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	na	na
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	na	na
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	na	na
Effective RSI / R Value of Entire Assembly		3.16	17.96	3.08	17.51	3.19	18.14	0.00	0.00
With HRV		3.16	17.96	3.08	17.51	3.19	18.14	0.00	0.00

2x6 framing filled with R22 batt @ 24" o.c. and exterior strapping									
		VINYL SIDING		CEMENT FIBRE		WOOD SIDING		STUCCO	
WALL ASSEMBLY COMPONENTS:		RSI	R	RSI	R	RSI	R	RSI	R
1	exterior air film	0.03	0.17	0.03	0.17	0.03	0.17	na	na
2	Cladding (no air space) as noted in the heading	0.11	0.63	0.03	0.17	0.14	0.80	na	na
2a	Strapping	0.16	0.91	0.16	0.91	0.16	0.91	na	na
3	asphalt impregnated paper ²	0.00	0.00	0.00	0.00	0.00	0.00	na	na
4	7/16" (11.1 mm) OSB sheathing	0.11	0.63	0.11	0.63	0.11	0.63	na	na
5	2x6 framing filled with R22 batt @ 24" o.c.	2.67	15.18	2.67	15.18	2.67	15.18	na	na
6	polyethylene	0.00	0.00	0.00	0.00	0.00	0.00	na	na
7	1/2" (12.7 mm) gypsum board	0.08	0.45	0.08	0.45	0.08	0.45	na	na
8	finish: 1 coat latex primer and latex paint	0.00	0.00	0.00	0.00	0.00	0.00	na	na
9	interior air film	0.12	0.68	0.12	0.68	0.12	0.68	na	na
Effective RSI / R Value of Entire Assembly		3.28	18.65	3.20	18.19	3.31	18.82	0.00	0.00
With HRV		3.28	18.65	3.20	18.19	3.31	18.82	0.00	0.00

Minimum effective RSI without HRV installed - 3.08

Minimum effective RSI with HRV installed - 2.97