

附 錄



附錄一、名詞解釋

本文使用地震與保險的專有名詞甚多，包括很多工程、地質的專業用語。在此針對本研究所引用且必須清楚定義的名詞做闡釋。

震源 (Hypocenter)

地震發生的起始位置，斷層開始破裂的地方，震源向上投影到地表即為震央。利用地震波，可以決定震源。依照震源的深度可將地震分為淺層、中層和深層地震。

震央 (Epicenter)

地震發生時，地震震源向上垂直投影到地面的位置，也就是地面距震源最近的地方，稱為震央。

震度 (Intensity)

地震發生時，地面上的人所感受到震動的激烈程度，一般而言，離震央愈近，震度愈大。我國依地表加速度 PGA，將地震分為 6 級。

規模 (Magnitude)

地震本身威力的大小，與其所釋放的能量有關。每次地震發生時，地震規模僅有單一數值，不因觀測位置不同而變。目前最常採用的是芮氏等級(Richter Scale)，係 1935 年由加州理工學院教授所定義。

最大地表加速度(Peak Ground Acceleration, PGA)

隨著與震源距離、地質特性，地表會呈現不同程度的搖晃。PGA 係指地震在某特定地區造成的搖晃過程中，最大的地表加速度。

回歸期 (Return Period)

一特定規模的天災，如颱風、地震等，其再發生的間隔，稱為回歸期。地震發生通常以 poisson process 模擬，計算式為 $R_d = 1 - \exp(-T_d/T_r)$ ，其中 R_d 為年超越機率（危害度）， T_d 為固定期間，如建築物使用年限， T_r 為回歸期。

可能最大損失 PML (Probable Maximum Loss)

在火災保險上，係指事故發生時，標的物內的消防安全設施依平時保養維護狀況的

信賴度，決定發揮可預期功能下之最大可能損失。在地震保險上，通常指扣除被保險人的自負額，但尚未考慮再保險的保險公司簽單損失金額。

PML 475 (500)

台灣和美國的建築法規要求建築物的抗震能力是以房屋耐用年限 50 年間之損害超越機率 10% 來做設計，其回歸期相當於 475 年，亦即年發生率 $1/475$ ，一般也稱為 PML500。在這種規模的大地震下，震央附近的建築物已近全損但不應倒塌，以確保建物內的人員逃生。此處的回歸期可以採用損失超越機率或是事件超越機率，一般使用損失超越機率。

PML 250

一般國際上在評估巨災多以 250 年損失超越回歸期為基準，相當於 50 年超越機率 18% 或年超越機率 0.4%。

附錄二、台灣 RBC 公式說明

代號	說明
R0: 資產風險--關係人風險	本列係指保險業投資於關係人交易所持有之各項資產，可能因其資產價值變動而影響保險業失卻清償能力之風險。
R1: 資產風險--非關係人風險	本列係指保險業投資於非關係人交易所持有之各項資產，可能因其資產價值變動而影響保險業失卻清償能力之風險。
R1o: 資產風險--非股票之資產風險	本列為依據前項「R1:資產風險--非關係人風險」再細分為非關係人非股票之資產風險，以調整各項風險之相關程度。
R1s: 資產風險--非關係人股票風險	本列為依據前項「R1:資產風險--非關係人風險」再細分為非關係人股票之資產風險，以調整各項風險之相關程度。
R2: 信用風險	本列係指保險業因交易對象不履行義務而影響保險業失卻清償能力之風險。
R3a: 核保風險--準備金風險	本列係指保險業經營業務時針對已簽單業務低估負債之風險。
R3b: 核保風險--保費風險	本列係指保險業經營業務對於未來新簽單契約費率定價不足之風險。
R4: 資產負債配置風險	本列係指保險業因外在環境之原因，包括利率、政策、法令及巨災等變動因素，造成資產與負債價值變動不一致之風險。
R5: 其他風險	本列係指保險業除上述四大項風險外可能面對的其他風險，主要包含項目為營運風險，係指保險業因營運上各項因素所導致的直接或間接的可能損失。
風險資本總額	本列為將各風險項目依風險資本總額計算式計算所得之金額。
自有資本總額	本列為自有資本總額計算表之總金額，加總項目包括業主權益、危險變動特別準備金、股票投資未實現評價利益。
資本適足比率	本列為自有資本總額除以風險資本總額所得之比率。

資料來源：金管會網站

附錄三、日本 RBC 所規定之天災風險

Major Catastrophe Risks:

Super Typhoon Vera (T5915/伊勢湾台風 in Japan) was the strongest typhoon to hit Japan in recorded history. With winds of 160 mph, Vera slammed into the southern coast of Japan, causing widespread damage and flooding, with over 5,000 dead. Japan Meteorological Agency gave a special name to Vera: "Isewan Typhoon".

2004 版：The amount of damage caused by an earthquake similar to the Great Kanto Earthquake in scale or a typhoon similar to Typhoon Mireille in 1991 in gravity. Shall be deemed to be the risk.

最新版：For example, the per-occurrence measure for earthquake is the Great Kanto Earthquake scale (1-250 yrs), and the per-occurrence measure for typhoon is Typhoon Vera in 1959 (1-70 yrs).

資料來源：Katsura Saito, Catastrophe Risks and Reinsurance in Japan, Oct 2004

附錄四、美國 RBC 監理行動水準

風險基礎資本額比率 (RBC Ratio)	授權控制水準 (ACL)	行動水準 (Action Level)	監理行動
100%以上	200%以上	無行動水準階段 (No Action Level)	無需採取任何監理行動，但若 RBC Ratio 落在 200%~250% 之間，必須作趨勢分析(trend test)，若未通過則落入公司行動水準階段
100%~75%	200%~150%	公司行動標準 (Company Action Level)	保險公司需提供詳盡改善公司財務狀況或解決財務問題之財務計劃予州保險監理官，若未被州保險監理官接受，則落入監理行動水準階段
75%~50%	150%~100%	監理行動標準 (Regulatory Action Level)	保險公司需提供改正行動計劃，另外，監理官得檢視或分析保險公司的營運活動，並要求改善財務問題
50%~35%	100%~70%	授權控制標準 (Authorized Control Level)	此時保險公司的資產可能尚大於負債，惟法律已賦予州保險監理官可採取必要行動之權利
35%以下	70%以下	強制控管標準 (Mandatory Control Level)	州保險監理官必須採取強制且必要的行動以接管保險公司

註：Authorized Control Level (ACL) = 2 x RBC

資料來源：

1. 敬永康、葉詩瑾，運用風險值模型衡量保險業之風險基礎資本額，貨幣觀測與信用評等，September 2001
2. 美國精算師協會網站

附錄五、美國加州地震分區

Earthquake Zones and Subzones

- Zone A: San Francisco Bay Area and North Coast Counties
Subzone A-1: San Francisco and San Mateo Counties
Subzone A-2: Alameda and Contra Costa Counties
Subzone A-3: Del Norte, Humboldt, Lake, Marin, Mendocino, Monterey, Napa, San Benito, Santa Clara, Santa Cruz, Solano, and Sonoma Counties
- Zone B: Los Angeles/Orange Counties (see Figure 2)
Subzone B-1: Los Angeles County, west of Los Angeles downtown section (west of Interstate 5 & south of Mulholland Drive (crest of the Santa Monica Mountains))
Subzone B-2: remainder of Los Angeles County, east of Los Angeles downtown section
Subzone B-3: Orange County
- Zone C: Kern, San Luis Obispo, Santa Barbara, and Ventura Counties
- Zone D: San Diego County
- Zone E: South-East California
Alpine, Imperial, Inyo, Mono, Riverside, and San Bernardino Counties
- Zone F: Central California
Fresno, Kings, Madera, Mariposa, Merced, and Tulare Counties
- Zone G: North - Central California
Amador, Butte, Calaveras, Colusa, El Dorado, Glenn, Nevada, Placer, Sacramento, San Joaquin, Stanislaus, Sutter, Tuolumne, Yolo, and Yuba Counties
- Zone H: Northern California, except coastal
Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama, and Trinity Counties

附錄六、加州地震監理申報範例

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SUBZONE A-1 COUNTIES: San Francisco and San Mateo (In thousands of dollars)

Part I: Insurance on structures of 8 stories or less:

Column 1 Earthquake class and standard deductible (See Instructions)	Column 2 Aggregate Direct Liability	Column 3 Aggregate Direct PML	Column 4 Aggregate Liability Net of Reinsurance	Column 5 Minimum PML Percentage	Column 6 Estimated PML on Net Liability
1A 1-4 Family-1% or flat	33,679	597	33,011	6.75%	564
1A 1-4 Family 5%	205,726	13,519	119,135	3.63%	7,747
1A 1-4 Family 10%	1,368,827	43,485	634,377	2.13%	22,944
1B "Homeowners" - 1% or flat	23,068	1,736	21,855	6.75%	1,493
1B "Homeowners" 5%	776,937	23,732	775,549	3.63%	23,681
1B "Homeowners" 10%	943,617	19,760	798,436	2.13%	15,928
1B "Homeowners" 15% & up	1,746,023	27,866	750,244	1.38%	11,567
1B "Homeowners" 15% "Mini"	10,798,584	121,059	10,422,977	0.69%	118,465
1B "Homeowners" "Wrap"	125	4	125	2.94%	4
1C Wood Frame - small 5%	740,011	16,179	622,420	3.00%	13,549
1D Wood - other 5%	1,224,304	69,124	917,533	10.00%	52,275
1E Mobile Homes 2%	35,435	1,793	35,170	5.00%	1,759
2A Metal - small 5%	26,697	1,701	23,852	2.00%	1,649
2B Metal - other 5%	52,553	11,107	43,259	10.00%	9,386
3A Steel 5%	274,543	98,987	128,954	15.00%	47,638
3B Steel 5%	129,741	56,027	104,127	25.00%	34,009
3C Steel 10%	107,169	29,886	37,759	25.00%	10,127
4A Concrete 5%	1,151,865	320,205	1,009,154	20.00%	235,134
4B Concrete 5%	74,683	38,251	36,102	35.00%	19,236
4C Concrete 10 %	110,587	57,794	44,230	50.00%	22,550
4D Concrete 10 %	25,262	14,952	2,287	45.00%	1,760
5A Mixed 5%	386,000	167,186	196,789	25.00%	63,739
5B Mixed 10%	11,649	6,314	8,215	60.00%	4,754
5C Mixed 10%	99,842	75,438	40,962	75.00%	31,094
6 EQ resistive 5%	24,320	18,245	7,504	10.00%	3,417
Risks in above classes not written at standard deductible	4,694,804	794,276	2,932,063	xxx	442,532
Sub-Totals:	25,066,051	2,029,225	19,746,090		1,197,004

Part II: Insurance on structures of over 8 stories:

Column 1 Earthquake class and standard deductible (See Instructions)	Column 2 Aggregate Direct Liability	Column 3 Aggregate Direct PML	Column 4 Aggregate Liability Net of Reinsurance	Column 5 Minimum PML Percentage	Column 6 Estimated PML on Net Liability
3A Steel 5%	204,903	86,930	74,813	15.00%	42,324
3B Steel 5%	120,900	40,513	66,750	25.00%	17,025
3C Steel 10%	0	0	0	25.00%	0
4A Concrete 5%	272,715	118,849	159,848	20.00%	36,556
4B Concrete 5%	28,000	20,297	10,500	35.00%	7,975
4C Concrete 10 %	0	0	0	50.00%	0
4D Concrete 10 %	0	0	0	45.00%	0
5A Mixed 5%	112,382	65,729	30,136	25.00%	14,093
5B Mixed 10%	392	235	392	60.00%	235
5C Mixed 10%	0	0	0	75.00%	0
6 EQ resistive 5%	59,694	5,969	23,031	10.00%	2,303
Risks in above classes not written at standard deductible	316,564	137,366	181,185	xxx	56,369
Sub-Totals:	1,115,550	475,887	546,655		176,880

Part III: Other types of risks:

	Column 1 Aggregate Direct Liability	Column 2 Aggregate Direct PML	Column 3 Aggregate Liability Net of Reinsurance	Column 4 Estimated PML on Net Liability
(1) Class 7 and commercial inland Exceptions	1,832,534	560,020	150,194	83,692
(2) Commercial inland addenda	525,804	87,496	85,944	12,841
(3) Liabilities assumed: pools and associations (e.g., FAIR Plan, IRI)	1	0	1	0
(4) All other (e.g., earthquake, sprinkler leakage)	6,285,194	721,699	2,911,946	288,111
Sub-Totals:	8,643,534	1,369,215	3,148,085	384,644
ZONE TOTALS	34,825,135	3,874,327	23,440,830	1,758,528

附錄七、加州地震保險法規原文

加州保險部 email 回覆：

Yes, California Code of Regulations section 2307 requires that insurers' file Probably Maximum Loss reports with the California Department of Insurance every 2 years.

加州地震保險法規原文

§2307. California Earthquake Zoning and Probable Maximum Loss Evaluation Program.

All insurers transacting property insurance in this State must record earthquake liabilities written in this State and develop statistics in accordance with the instructions contained in the Insurance Department, California Earthquake Liability Report Form.

Insurers specializing in the writing of unique or unusual risks may report on forms and plans that are submitted to the Insurance Department and found to be compatible with the uniform form. Exceptions will be granted only where compatibility is clearly demonstrated by the insurer.

(a) Insurers must provide their reinsurers zone, construction, PML and deductible information on the same basis and format as they submit to the Insurance Department for liabilities ceded under each reinsurance treaty other than catastrophe treaties. Reinsurers shall combine this information with their own facultative recordings for a total aggregate probable maximum loss estimate on their writings.

(b) Insurers writing risks under excess of loss, loss limit, aggregate, stop loss or similar covers must report the following information: 1. Zone designation 2. Company aggregate limit 3. Net probable Maximum Loss Insurers are expected to develop and maintain information on methodology of determining Net Probable Maximum Loss for review by the Department's examiners.

(c) Reports shall be filed with the Commissioner as an Addendum to the insurer's Annual Statement as of December 31st of each calendar year and shall be due June 30th of the following year. The first Earthquake Liability Report shall be due June 30, 1980, for the year ending December 31, 1979, and shall cover only policies written and effective on or after January 1, 1979.

資料來源：美國加州保險部網站

附錄八、加拿大住宅與商業地震預設損失表

British Columbia - Personal Property Shake				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 shake factor %	500 shake factor %
Zone 1 Richmond, Fraser Delta	V3M, V4G, V4K, V6V-Y, V7A-E,		5.88	10.76
Zone 2 Rest of Greater Vancouver	Rest of V3, V4, V5, V6, V7		2.25	4.31
Zone 3 Victoria	V8N-Z, V9A-E		1.02	2.19
Zone 4 Rest of Vancouver Earthquake Zone	V8A, V8L, V9L-Y, V2P-Z, V0M-S, V0X, V1M, V4W, V4X, V4R, V3G		1.05	2.30
Zone 11 British Columbia excluding zones 1-4	remainder of V codes		0.03	0.07
Total BC personal property shake PML				
Note: Total sum insured x 250 shake factor = 250 shake PML for each CRESTA zone Total sum insured x 500 shake factor = 500 shake PML for each CRESTA zone				
Total = sum of shake PML for each CRESTA zone				

British Columbia - Personal Property Fire				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 fire factor %	500 fire factor %
Zone 1 Richmond, Fraser Delta	V3M, V4G, V4K, V6V-Y, V7A-E,		2.02	2.90
Zone 2 Rest of Greater Vancouver	Rest of V3, V4, V5 V6, V7		2.36	3.09
Zone 3 Victoria	V8N-Z, V9A-E		0.98	0.94
Zone 4 Rest of Vancouver Earthquake Zone	V8A, V8L, V9L-Y, V2P-Z, V0M-S, V0X, V1M V4W, V4X, V4R, V3G		0.39	0.46
Zone 11 British Columbia excluding zones 1-4	remainder of V codes		0.03	0.03
Total BC personal property fire PML				
Note: Total sum insured x 250 fire factor = 250 fire PML for each CRESTA zone Total sum insured x 500 fire factor = 500 fire PML for each CRESTA zone				
Total = sum of fire PML for each CRESTA zone				

Quebec - Personal Property Shake				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 shake factor %	500 shake factor %
Zone 5 Montreal	H		3.11	6.38
Zone 6 Greater Montreal	J3V-Z, J4, J5R, J6W-Z, J7A-R, J0N		1.69	4.12
Zone 7 Surroundings of Montreal	J2S-X, J3A-L, J5Y-Z, J6A-T, J7V-Z, J0J-L, J0P-S		1.85	4.18
Zone 8 Rest of Montreal Earthquake Zone	G8Y-Z, G9A-C, J1E-X, J2B-N, J3P-R, J5V, J8C-H, J0C-H, J0T-V, K6A-K, K0B-C		1.30	2.44
Zone 9 Quebec City and Epicentral Region	G1, G2, G5V, G6V-W, G0A, G0L, G0R, G0T		1.14	3.01
Zone 10 Rest of Quebec Earthquake Zone	G5L-R, G5Y, G6G-T, G7, G8B-H, G8T-Z, G9, G0K, G0M-P, G0S, G0V, G0X-Z		0.37	0.78
Zone 16 Quebec	excluding zones 5-10		0.77	1.40
Total Quebec personal property shake				
Note: Total sum insured x 250 shake factor = 250 shake PML for each CRESTA zone Total sum insured x 500 shake factor = 500 shake PML for each CRESTA zone				
Total = sum of shake PML for each CRESTA zone				

Quebec - Personal Property Fire				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 fire factor %	500 fire factor %
Zone 5 Montreal	H		1.25	5.95
Zone 6 Greater Montreal	J3V-Z, J4, J5R, J6W-Z, J7A-R, J0N		0.40	1.27
Zone 7 Surroundings of Montreal	J2S-X, J3A-L, J5Y-Z, J6A-T, J7V-Z, J0J-L, J0P-S		0.28	0.87
Zone 8 Rest of Montreal Earthquake Zone	G8Y-Z, G9A-C, J1E-X, J2B-N, J3P-R, J5V, J8C-H, J0C-H, J0T-V, K6A-K, K0B-C		0.22	0.58
Zone 9 Quebec City and Epicentral Region	G1, G2, G5V, G6V-W, G0A, G0L, G0R, G0T		0.50	2.62
Zone 10 Rest of Quebec Earthquake Zone	G5L-R, G5Y, G6G-T, G7, G8B-H, G8T-Z, G9, G0K, G0M-P, G0S, G0V, G0X-Z		0.17	0.38
Zone 16 Quebec	excluding zones 5-10		0.07	0.38
Total Quebec personal property fire PML				
Note: Total sum insured x 250 fire factor = 250 fire PML for each CRESTA zone Total sum insured x 500 fire factor = 500 fire PML for each CRESTA zone				
Total = sum of fire PML for each CRESTA zone				

British Columbia - Commercial Property Fire				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 fire factor %	500 fire factor %
Zone 1 Richmond, Fraser Delta	V3M, V4G, V4K, V6V-Y, V7A-E,		0.94	1.26
Zone 2 Rest of Greater Vancouver	Rest of V3, V4, V5, V6, V7		1.52	1.80
Zone 3 Victoria	V8N-Z, V9A-E		0.56	0.69
Zone 4 Rest of Vancouver Earthquake Zone	V8A, V8L, V9L-Y, V2P-Z, V0M-S, V0X, V1M, V4W, V4X, V4R, V3G		0.22	0.30
Zone 11 British Columbia excluding zones 1-4	remainder of V codes		0.03	0.03
Total BC commercial property fire PML				
Note: Total sum insured x 250 fire factor = 250 fire PML for each CRESTA zone Total sum insured x 500 fire factor = 500 fire PML for each CRESTA zone				
Total = sum of fire PML for each CRESTA zone				

British Columbia - Commercial Property Shake				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 shake factor %	500 shake factor %
Zone 1 Richmond, Fraser Delta	V3M, V4G, V4K, V6V-Y, V7A-E,		10.92	15.43
Zone 2 Rest of Greater Vancouver	Rest of V3, V4, V5 V6, V7		4.68	6.67
Zone 3 Victoria	V8N-Z, V9A-E		2.67	4.58
Zone 4 Rest of Vancouver Earthquake Zone	V8A, V8L, V9L-Y, V2P-Z, V0M-S, V0X, V1M, V4W, V4X, V4R, V3G		2.29	4.15
Zone 11 British Columbia excluding zones 1-4	remainder of V codes		0.10	0.13
Total BC commercial property shake PML				
Note: Total sum insured x 250 shake factor = 250 shake PML for each CRESTA zone Total sum insured x 500 shake factor = 500 shake PML for each CRESTA zone				
Total = sum of shake PML for each CRESTA zone				

Quebec - Commercial Property Fire				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 fire factor %	500 fire factor %
Zone 5 Montreal	H		0.45	1.49
Zone 6 Greater Montreal	J3V-Z, J4, J5R, J6W-Z, J7A-R, J0N		0.17	0.35
Zone 7 Surroundings of Montreal	J2S-X, J3A-L, J5Y-Z, J6A-T, J7V-Z, J0J-L, J0P-S		0.08	0.25
Zone 8 Rest of Montreal Earthquake Zone	G8Y-Z, G9A-C, J1E-X, J2B-N, J3P-R, J5V, J8C-H, J0C-H, J0T-V, K6A-K, K0B-C		0.08	0.23
Zone 9 Quebec City and Epicentral Region	G1, G2, G5V, G6V-W, G0A, G0L, G0R, G0T		0.22	0.57
Zone 10 Rest of Quebec Earthquake Zone	G5L-R, G5Y, G6G-T, G7, G8B-H, G8T-Z, G9, G0K, G0M-P, G0S, G0V, G0X-Z		0.08	0.13
Zone 16 Quebec	excluding zones 5-10		0.05	0.12
Total Quebec commercial property fire PML				
Note: Total sum insured x 250 fire factor = 250 fire PML for each CRESTA zone Total sum insured x 500 fire factor = 500 fire PML for each CRESTA zone				
Total = sum of fire PML for each CRESTA zone				

Quebec - Commercial Property Shake				
CRESTA ZONE	POSTAL CODES	Total Sum Insured	250 shake factor %	500 shake factor %
Zone 5 Montreal	H		5.43	10.74
Zone 6 Greater Montreal	J3V-Z, J4, J5R, J6W-Z, J7A-R, J0N		3.62	8.35
Zone 7 Surroundings of Montreal	J2S-X, J3A-L, J5Y-Z, J6A-T, J7V-Z, J0J-L, J0P-S		3.51	7.41
Zone 8 Rest of Montreal Earthquake Zone	G8Y-Z, G9A-C, J1E-X, J2B-N, J3P-R, J5V, J8C-H, J0C-H, J0T-V, K6A-K, K0B-C		2.77	4.66
Zone 9 Quebec City and Epicentral Region	G1, G2, G5V, G6V-W, G0A, G0L, G0R, G0T		2.35	4.61
Zone 10 Rest of Quebec Earthquake Zone	G5L-R, G5Y, G6G-T, G7, G8B-H, G8T-Z, G9, G0K, G0M-P, G0S, G0V, G0X-Z		0.80	1.52
Zone 16 Quebec	excluding zones 5-10		1.12	1.84
Total Quebec commercial property shake PML				
Note: Total sum insured x 250 shake factor = 250 shake PML for each CRESTA zone Total sum insured x 500 shake factor = 500 shake PML for each CRESTA zone				
Total = sum of shake PML for each CRESTA zone				