Seminole Reinsurance Company

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Our analysis and review of ABC Insurance Company's Book of Business

Seminole Reinsurance Company is reviewing the book of business we reinsure for ABC Insurance Company. We reviewed the CAT modeling used to underwrite Cal State University – Northridge to make sure that we agree with the scenarios and numbers used. It is important that we look at the same data and draw the same conclusions. In the first part of our report, we will discuss the benefits of catastrophe modeling as well as our findings when we tested your model. In the second part, we will discuss the actual historical cost of damages and whether any specific building characteristics were important for predicting those costs. We must also take into account that these natural disasters are created by power that cannot be predicted. (Born, 2023) Earthquakes, Hurricanes and other storms can create Bell-Weather losses that can put insurance companies to insolvency.

CAT Modeling is what you make of it. The figures, centroids and output are only as good as the input that you put in. We did not focus our studies of this book centered around co-location vs. putting a building precisely where it is to be. What we would expect would be that buildings further from fault lines should show a noted difference in expected losses. Buildings that are closer to the fault line may experience more damage and may need protective measures more than those farther away. Most of this campus is fairly concentrated within one area of town and we should not expect too much of a difference. I would see for a CAT Model to work properly; you should put all data in that is needed. This is like forgetting to put construction type or stories of a building. These are figures that do matter.

We also find that Cat Models are Epistemic in that CM is not a model but a series of models and rely on the input data, and user interpretation. Output from one model is entered into or correlated with output from another mode and input into other models and so forth so the end result is not the result of single platform solution. (Born, 2023)

Findings of Outputs (compare outputs)

10000		AGG EV	AGG SD	OCC EV	OCC SD
Compare 1 to 2 (actual construction to all steel)					
6 | Business/Education Complex | BB	ACTUAL	37	326	37	326
6 | Business/Education Complex | BB	STEEL	37	326	37	326
16 | Oviatt Library | OV	ACTUAL	37	325	37	324
16 | Oviatt Library | OV	STEEL	32	285	32	284
33 | University Student Union | USU	ACTUAL	60	502	60	501
33 | University Student Union | USU	STEEL	25	213	25	213
Total for All 34 Locations in Contract	ACTUAL	805	6925	801	6911
Total for All 34 Locations in Contract	STEEL	587	5135	584	5124
Compare 1 to 3 (actual height to average height)					
6 | Business/Education Complex | BB	ACTUAL	37	326	37	326
6 | Business/Education Complex | BB	AVG HT	37	316	37	315
16 | Oviatt Library | OV	ACTUAL	37	325	37	324
16 | Oviatt Library | OV	AVG HT	54	463	54	462
33 | University Student Union | USU	ACTUAL	60	502	60	501
33 | University Student Union | USU	AVG HT	44	378	44	377
Total for All 34 Locations in Contract	ACTUAL	805	6925	801	6911
Total for All 34 Locations in Contract	AVG HT	829	7139	824	7125
Compare 1 to 5 (Actual location to co-located)					
6 | Business/Education Complex | BB	ACTUAL	37	326	37	326
6 | Business/Education Complex | BB	CO-LOC	38	331	38	330
16 | Oviatt Library | OV	ACTUAL	37	325	37	324
16 | Oviatt Library | OV	CO-LOC	38	331	38	331
33 | University Student Union | USU	ACTUAL	60	502	60	501
33 | University Student Union | USU	CO-LOC	33	289	33	288
Total for All 34 Locations in Contract	ACTUAL	805	6925	801	6911
Total for All 34 Locations in Contract	CO-LOC	778	6728	774	6714

50000		AGG EV	AGG SD	OCC EV	OCC SD
Compare 9 to 10 (actual construction to all steel)					
6 | Business/Education Complex | BB	ACTUAL	33	300	32	299
6 | Business/Education Complex | BB	STEEL	33	300	32	299
16 | Oviatt Library | OV	ACTUAL	32	298	32	298
16 | Oviatt Library | OV	STEEL	28	262	28	261
33 | University Student Union | USU	ACTUAL	52	457	51	456
33 | University Student Union | USU	STEEL	22	196	22	196
Total for All 34 Locations in Contract	ACTUAL	697	6312	693	6296
Total for All 34 Locations in Contract	STEEL	513	4720	510	4709
Compare 9 to 11 (actual height to average height)					
6 | Business/Education Complex | BB	ACTUAL	33	300	32	299
6 | Business/Education Complex | BB	AVG HT	33	291	32	290
16 | Oviatt Library | OV	ACTUAL	32	298	32	298
16 | Oviatt Library | OV	AVG HT	47	421	46	420
33 | University Student Union | USU	ACTUAL	52	457	51	456
33 | University Student Union | USU	AVG HT	39	345	38	344
Total for All 34 Locations in Contract	ACTUAL	697	6312	693	6296
Total for All 34 Locations in Contract	AVG HT	717	6504	713	6489
Compare 9 to 13 (Actual location to co-located)					
6 | Business/Education Complex | BB	ACTUAL	33	300	32	299
6 | Business/Education Complex | BB	CO-LOC	33	303	33	302
16 | Oviatt Library | OV	ACTUAL	32	298	32	298
16 | Oviatt Library | OV	CO-LOC	33	302	33	302
33 | University Student Union | USU	ACTUAL	52	457	51	456
33 | University Student Union | USU	CO-LOC	28	259	28	258
Total for All 34 Locations in Contract	ACTUAL	697	6312	693	6296
Total for All 34 Locations in Contract	CO-LOC	671	6107	667	6092

Inputs to CAT Model

There are many variables considered when entering this data. We compared characteristics of construction like steel, reinforced concrete and wood. If you look across the campus you will see a mixture of all three spread throughout the buildings. We selected three buildings with different materials to test the model. One thing you also have to consider is that building codes change over time and these buildings were not constructed at the same time. A primary reason for this is that building code creates model uncertainty as no one knows if new building codes decrease risk until an event occurs. However, replacement of existing buildings after an earthquake loss should reduce future risk if new buildings are built to new codes. (Born, 2023)

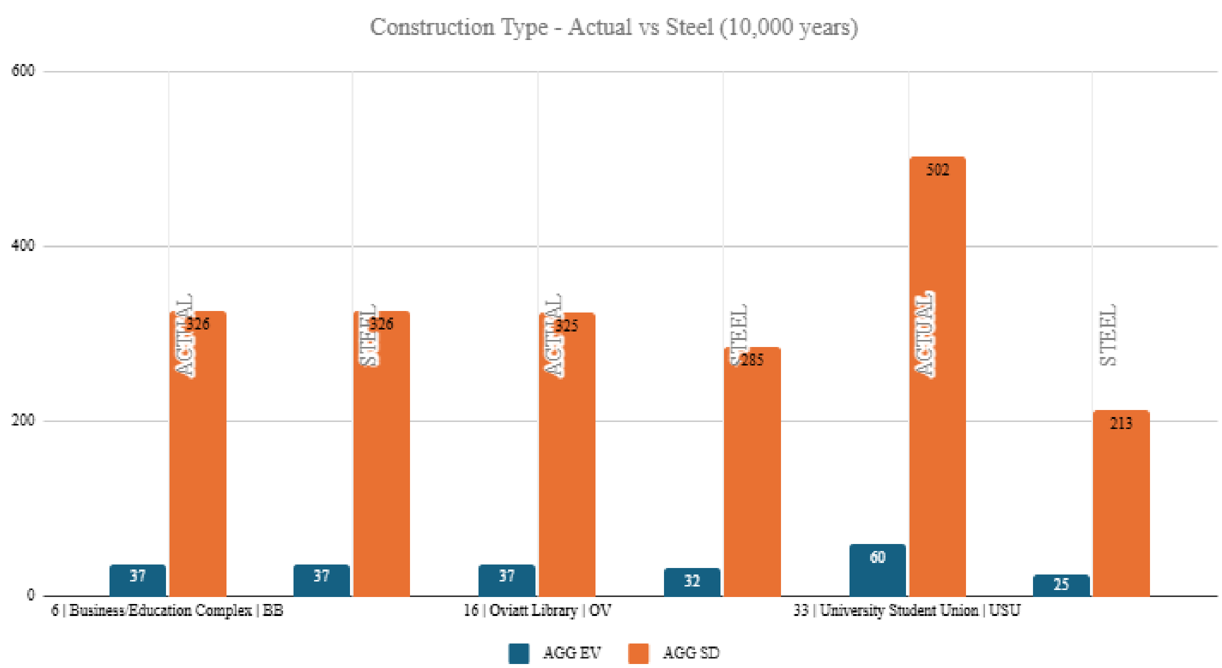
You have buildings built in the 70's and maybe some are older. We feel that we have learned many great things about construction in the last 50 plus years. You have buildings that are 1 story up to 6 or 8 stories. Building costs change throughout time and are much more expensive today than they were back then. This model does not consider those increased rebuilding costs or the changes in building codes. This could change the dynamics of this book drastically. We would like to see these factors added to the model.

One factor that must be reviewed is if a building is co-located or precisely placed and measured. The buildings we selected are relatively close together. So, we will need to do further testing to see if the model is effective at calculating this variable. The reason that all of these details are so critical is if we do not have precise data to measure within a CAT model, then we should not enter the data at all. The quality of data inputs is so important, or the output is not worth looking at.

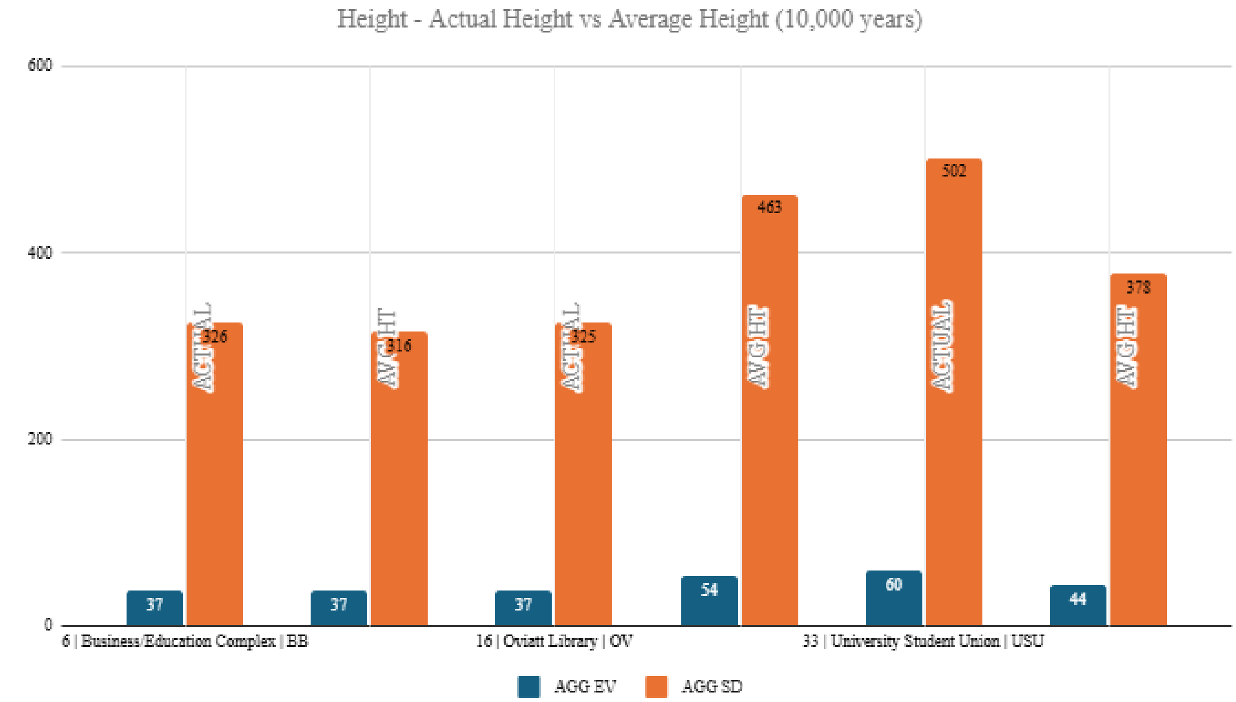
The height of a building is also critical to preparing for CAT loads. Many of the buildings around our campus are single family homes. One story does not have the pressure and weight pushing down on it the way a 6 or 8 story building would. If you have a house or single-story building made of wood, that may not be as heavy and crushing as many stories of cement and steel.

More Findings

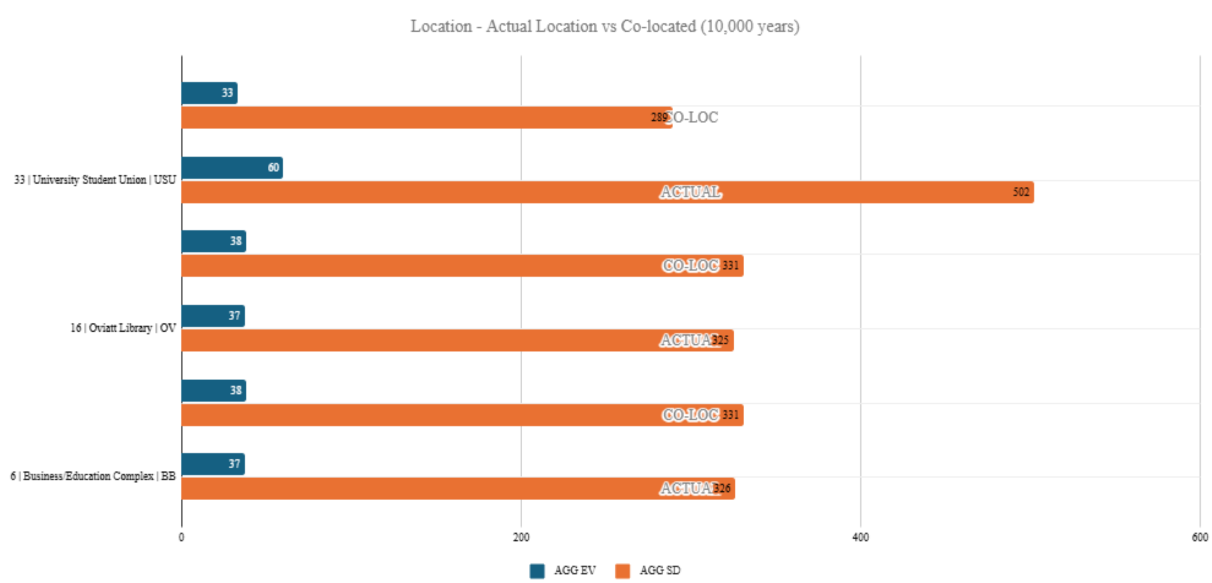
Part 1 - 10,000 years



Under the model for 10,000 years, we are noticing that when looking at actual vs. all steel, the numbers are consistent unless you look at the Student Union. The Student Union reflects $60,000 (wood) vs. $25,000 (all steel) Agg EV. When you look at the Standard Deviation, you are looking at $502,000 (wood) and $213,000 (all steel). This would suggest that the model predicts a higher probability of damage to a wooden building than a steel building. This makes sense, but the rebuilding costs associated with steel would be much greater than wood. Therefore, we question whether the predicted costs are actually accurate.



When you move to actual height vs. average height, the actual AGG EV for the Oviatt Library is $17,000 less than the average height of the same construction type. The average height loss is $16,000 less than the actual height losses for the Student Union building. This indicates that the library is shorter than the average height while the Student Union is taller than average. The Business/Education Complex appears to be near the average height.



To us, the co-location vs. actual and precise location should not be too far apart. They are very similar in location and close to the centroid. Everything does stay constant with the numbers except for the co-location of the Student

Union vs. the actual location. For the Agg EV you see $60,000 actual vs. $33,000 co-located. We do not understand how these numbers could be this far apart, since the Student Union is just slightly east of the other two buildings.

The above information gives us questions that we must ask. How do we know that we can count on the data included in the CAT model? What source was this information from, and do we know that it is accurate? How are these calculations made? We also notice that rebuilding costs for the Student Union should be less than the other buildings since they are made of wood. Considering that there are 34 buildings made of different materials, how does the Student Union represent 7.5% of the actual Agg EV?

Part 1 - 50,000 years

We find many of the same patterns with the 10,000-year model. Actual (wood) vs. all-steel for the Student Union building are at $50,000 in losses vs. $22,000 in losses. The other buildings stay consistent.

Actual height vs. average height for the Student Union building you see $52,000 Agg EV vs. $39,000. All other buildings represent little change. When compared to the other 34 buildings, the Student Union is still 7.5% of the actual Agg EV.

Different Scenarios

There are many scenarios that we had to consider. We had to consider if the building was constructed with wood, steel or reinforced concrete. We then had to compare if the actual construction was better off with the actual or steel. We looked at the height of the three buildings that we chose and then compared them by looking at actual numbers vs. average height. The three buildings that we chose were all 3 or 4 stories. Therefore, other buildings would probably provide better testing of this variable in the model.

The buildings we looked at were made up of all 3 categories of construction materials. The Oviatt Library was 4 floors, built in 1978 and made up of reinforced concrete. We also looked at the Business / Education building that was 4 floors, built in 1994 and was constructed with steel. The last building we looked at was the Student Union, which was 3 floors, built in 1978 and is all wood. We liked the comparison of these buildings due to the floor height being similar, but they were all built differently. We were able to look clearly at different construction makeups which could give us a better feel for differences in many ways.

Part 2

Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.872783743
R Square	0.761751461
Adjusted R Square	0.668523772
Standard Error	3640.229588
Observations	33

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	974469919.2	108274435.5	8.170871441	2.3734E-05
Residual	23	304779243.4	13251271.45		
Total	32	1279249163			

		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Ind Variables	Intercept	95442.79195	122481.2344	0.779244203	0.443780442	-157928.946	348814.5297	-157928.9458	348814.5297
Square Ft.	129435	0.036400745	0.007003729	5.197337822	2.86297E-05	0.021912428	0.050889061	0.021912428	0.050889061
1992 Value	19902	-0.061358702	0.121328126	-0.505725296	0.617862189	-0.31234505	0.189627649	-0.312345053	0.189627649
Occupied	1964	-50.22757481	61.92413238	-0.811114712	0.425614241	-178.327403	77.87225291	-178.3274025	77.87225291
Floors	5	1726.733096	554.6915776	3.112960725	0.004894843	579.2661422	2874.200049	579.2661422	2874.200049
ReinfConc	0	127.0517548	2210.831379	0.057467863	0.954668861	-4446.4014	4700.504913	-4446.401404	4700.504913
Conc/Steel	1	607.3927275	2384.485737	0.254726928	0.801197801	-4325.29184	5540.077294	-4325.291839	5540.077294
Brick/Steel	0	-3157.692297	4263.985913	-0.740549421	0.466460121	-11978.4192	5663.034613	-11978.41921	5663.034613
Steel	0	-833.8509069	2689.013964	-0.310095417	0.759280764	-6396.50011	4728.798294	-6396.500107	4728.798294
Shear Wall	1	-422.7418949	1668.280447	-0.253399778	0.802210629	-3873.84294	3028.359147	-3873.842937	3028.359147

We ran a regression on the actual historical damage to the college. Orange cells in the chart above represent very important information. The P-Value shows that the square footage of the building and the number of floors were very significant factors in determining actual historical costs incurred. The coefficients tell us to expect $36 /sq ft of additional damage per every square foot of building. Also, to expect $1.726 M more in damage per every additional floor. This information will be very helpful in pricing policies going forward.

The high significance of those two factors along with the high R Square value means that we have accounted for the majority of the predictive values.

Outlook and Recommendations

There are many factors when looking at the construction materials that are used to create these buildings within seismic zones. Factors that are not considered within this study and CAT modeling include many things like how the concrete is poured or if maintenance is being done on reinforced concrete. Are the buildings being built with Base Isolation Systems which allow the building to detach from ground movement? This allows the building higher chances of survival. The Base Isolation Systems act as shock absorbers for a building. (concretecaptain.com, 2025)

Steel is an incredible building material that is flexible, and this is why many skyscrapers are built with steel. Steel can, in some cases, outperform conventional buildings by 30% during earthquakes. (concretecaptain.com, 2025) I would think that if you were looking to build taller buildings of 5 stories or more, you may look to steel or reinforced concrete. Another factor that must be considered is that steel can corrode, and this could cause major issues. (structuralguide.com, 2025) Steel can be cheaper than concrete but can also take longer to get due to having to be forged. We would recommend raising premiums on taller buildings that are not made of steel construction and having regular evaluations to prevent corroding on the insured buildings.

Another building material that fares better with earthquakes is concrete reinforced with steel or rebar. Many of your newer buildings use reinforced concrete. It has been proven that when an earthquake occurs, reinforced concrete can experience 50% less damage. If maintenance is not done properly with reinforced concrete, you can experience issues like structural giveaway. The Champlain Towers South building in Surfside, Florida is a perfect example of this. (architectmagazine.com, 2021) One important factor to consider with concrete is that it is the most expensive material to build with. The insured will have to weigh things like this out when building. (americanarchsteel.com, 2025) Some experts feel that concrete is a flawed building material. An issue with using reinforced concrete is that concrete and iron, which makes up steel, can react poorly together. (architectmagazine.com, 2021) We believe you should require scans of the concrete and steel at times to make sure they are structurally sound. This will help prevent insured losses.

Many engineers consider wood, and it has a strong case of stacking up against other building materials. There are many great qualities that wood has including being lightweight and buoyant. Many wood-built homes stand up against earthquakes better than masonry-built homes. Wood wins the flexibility contest against all others. (concretecaptain.com, 2025) Wood is five times lighter than concrete. This means that when an earthquake occurs there is less force pushing down on a building. (archdaily.com, 2024) Wood is three times as likely to withstand earthquakes than masonry. Looking at flexibility, think of how a tree flexes and bends with wind and storms. Wood as a building material can deal with a great deal of deformation before it breaks. (archdaily.com, 2024) Wood is readily available and cost effective when building or rebuilding in the future. We have to consider these things when insuring every building. If you pair wood with Base Isolation Systems like flexible foundations, counterweights, pendulums and straps to the foundation, you could have a winning formula.

We feel that overall wood could be the right choice when building and insuring the buildings on this campus, up to a certain height. One building on campus made of wood that we did look at and compared was building 33, the University Student Union built in 1978, and consists of 3 floors. Human nature makes you want to favor steel and concrete, but when looking at reinsuring buildings like this we must respect the data when it appears more favorable than our senses wish to believe.

Conclusion

Discussion of the benefits of CAT Modeling and a recommendation for strategy regarding the insured's use of CAT Modeling

One thing we noticed within CAT Modeling is that this modeling does not take into account when building codes change. When building codes change in areas like this, they help to reinforce good building practices that help a structure to withstand earthquakes and other perils. We find nowhere in the modeling that reflects this. Building Codes and those changes are only recognized after a catastrophic event, to see if they actually work. (Born, P., 2023) Another item that CAT modeling does not take into account is the replacement cost of materials to replace a building that may see structural damage. The benefits of using this modeling is that it helps to plan for the expected values of future losses. If we can have you add these additional variables into your model, we believe we can have much more accurate predictions for our policies moving forward.

We must all remember that Cat Modeling is an imperfect science that is a way to try and predict the future and it is difficult to predict future losses. Yes, this can give us an idea of what we may face. We have learned many things when it comes to wood, reinforced concrete and steel. We feel that we can plan for what type of losses each will have in an event. When planning with Cat modeling, we know that this is a way of planning. If you get ABC Insurance Company over-exposed, then there is always a chance of more losses for both of us. It is important to know that cost or rebuilding, demolition, and cost of materials always has an expense factor that must be planned for as well. We must work together to make the right decisions. Actuaries look at Cat Models as one source of information to justify rate making. These same actuaries must support rates that they file with state DOIs. (Born, 2023) I feel that we must use these models as one tool in our arsenal and must support all data in multiple ways when considering what our appetite must be.

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