

Benefit Cost Analysis of Hazard Mitigation Projects



Tornado and Hurricane Shelter Model

Version 1.0 - July 2000

Building Name: Scenario 1
Address: Lawrence, Kansas
County: Douglas
Disaster Number:
Project Number:
Scenario ID:
Analyst:
Date: Wednesday, April 13, 2005

FEMA Disclaimer:

The results produced by this analysis are neither conclusive evidence that the proposed project is cost-effective, nor a guarantee that a project is eligible for any government grant for whatever purpose.

*Input Data***Building Information****Building Longest Length (ft):** 50**Building Longest Width (ft):** 40**Shelter Area (square feet):** 2000**Shelter Construction Type:** Reinforced & Precast Concrete

Building has minimal window area of less than 7% of wall area.

**Hurricane Shelter
Occupancy: (people/day)** 0**Tornado Shelter
Occupancy** **Time Zone:** Central ST with Daylight Saving Time

12 am	350	12 pm	100
1 am	350	1 pm	50
2 am	350	2 pm	50
3 am	350	3 pm	50
4 am	350	4 pm	50
5 am	350	5 pm	100
6 am	300	6 pm	200
7 am	250	7 pm	250
8 am	150	8 pm	300
9 am	100	9 pm	300
10 am	50	10 pm	300
11 am	50	11 pm	350

Tornado Hazard Information

County Selection Method:

Only Douglas County, Kansas

Selected Counties:

Kansas Counties:

Douglas

Mitigation Project Information

Mitigation Project

Description:

Scenario 1, stand alone shelter, pre-cast and reinforced concrete construction

Project Cost (\$):	220,000
Maintenance Cost (\$):	500
Project Lifetime:	30
Discount Rate (%):	7
Injury Cost (\$/injury):	12,500
Death Cost (\$/life):	2,200,000
Design Wind Speed:[^] (3-second gust in mph)	250

Injury						Death					
<i>Pre-Mitigation</i>		<i>Effectiveness</i>		<i>Post-Mit.</i>		<i>Pre-Mitigation</i>		<i>Effectiveness</i>		<i>Post-Mit.</i>	
Wind Speeds (mph*)	Default % Injured	User- Defined %	Default %	User- Defined %	Calc. % Injured	Wind Speeds (mph*)	Default % Injured	User- Defined %	Default %	User- Defined %	Calc. % Injured
0 - 44	0		100		0.0	0 - 44	0		100		0.0
45 - 77	0.4		100		0.0	45 - 77	0		100		0.0
78 - 118	1		100		0.0	78 - 118	0.3		100		0.0
119 - 138	7		100		0.0	119 - 138	0.5		100		0.0
139 - 163	20		100		0.0	139 - 163	2		100		0.0
164 - 194	85		100		0.0	164 - 194	15		100		0.0
195 - 210	75		100		0.0	195 - 210	25		100		0.0
211 - 262	70		98		1.4	211 - 262	30		98		0.6
263 +	70		85		10.5	263 +	30		85		4.5

* 3-second gust

* 3-second gust

[^] From Figure 2-2 in Design and Construction Guidance for Community Shelters, Federal Emergency Management Agency, July 2000.

Hazard Statistics

Tornado Hazard for This Shelter

County Area (sq. miles): 480

Statistical Sample Region Area (sq. miles): 480

Years in Record: 46

Tornado F-Scale:	F0	F1	F2	F3	F4	F5	Total
<i>Number of Tornadoes in Record</i>	7	3	0	3	1	0	14
<i>Average Number of Tornadoes in County per Year</i>	0.1522	0.0652	0.0000	0.0652	0.0217	0.0000	0.3043
<i>Average On-Ground Length of Tornado Path (ft)</i>	4,433	21,040	0	81,916	14,202	0	121,591
<i>Average Area Disturbed by One Tornado (ac)</i>	8	136	0	3,985	430	0	4,559
<i>Average Annual Disturbed Area in County (ac)</i>	1	9	0	260	9	0	279
<i>Average Annual Tornado Hazard Area in County (ac)</i>	3	20	0	528	19	0	570
<i>Probability of Being in the Path of a Tornado (%)</i>	0.00112	0.00643	0.00000	0.17173	0.00623	0.00000	0.18550

Hurricane Hazard for This Shelter

50-year Exceedance Wind Speed From ASCE 7-98: 90
(3-second gust in mph)

Hurricane Wind Annual Probability

Wind Speed (mph*)	Probability (%)
0 - 44	0.00000
45 - 77	91.59176
78 - 118	8.32249
119 - 138	0.07660
139 - 163	0.00860
164 - 194	0.00054
195 - 210	0.00001
211 - 262	0.00000
263 +	0.00000
* 3-second gust	

Benefit Cost Analysis

Expected Annual Benefits from Tornado Mitigation (\$):	169,379
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Expected Annual Benefits from Hurricane Mitigation (\$):	0
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Total Expected Annual Benefits (\$):	169,379
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Annualized Project Costs (\$):	18,229
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Expected Annual Net Benefits (\$):	151,150
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Benefit Cost Ratio:	9.29
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Total Lives Saved Over Project Lifetime of 30 years	2.27
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Total Injuries Avoided Over Project Lifetime of 30 years	6.76
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Remarks

Selected counties do not have sufficient number of tornadoes for computing significant hazard statistics.