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

0

Occupancy: (people/day)

Tornado Shelter Occupancy

Time Zone: Central ST

with Daylight Saving Time

12 am	350	12 pm	100
1 am	350		50
	350	1 pm	
2 am		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
9			

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:^

250

(3-second gust in mph)

Injury	Pre-Mi	tigation	Effecti	veness	Post-Mit.	Death	Pre-Mi	tigation	Effecti	veness	Post-Mit.
Wind	Default	User-		User-	Calc.	Wind	Default	User-		User-	Calc.
Speeds	%	Defined	Default	Defined	%	Speeds	%	Defined	Default	Defined	%
(mph*)	Injured	%	%	%	Injured	(mph*)	Injured	%	%	%	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
Number of Tornadoes in Record	7	3	0	3	1	0	14
Average Number of Tornadoes in County per Year	0.1522	0.0652	0.0000	0.0652	0.0217	0.0000	0.3043
Average On-Ground Length of Tornado Path (ft)	4,433	21,040	0	81,916	14,202	0	121,591
Average Area Disturbed by One Tornado (ac)	8	136	0	3,985	430	0	4,559
Average Annual Disturbed Area in County (ac)	1	9	0	260	9	0	279
Average Annual Tornado Hazard Area in County (ac)	3	20	0	528	19	0	570
Probability of Being in the Path of a Tornado (%)	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
Expected Annual Benefits from Hurricane Mitigation (\$):	0
Total Expected Annual Benefits (\$):	169,379
Annualized Project Costs (\$):	18,229
Expected Annual Net Benefits (\$):	151,150
Benefit Cost Ratio:	9.29
Total Lives Saved Over Project Lifetime of 30 years	2.27
Total Injuries Avoided Over Project Lifetime of 30 years	6.76

Remarks

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