CHAPTER 8
BENEFIT-COST PROGRAM: LEVEL TWO ANALYSIS

Introduction

Chapter 6, Benefit-Cost Program: Level One Analysis, reviewed the data entries necessary to conduct a **LEVEL ONE (Minimum Data)** Benefit-Cost Analysis, relying heavily on default values built into the program. This chapter provides guidance on **LEVEL TWO (Detailed)** analyses which may incorporate much more building-specific data.

ALL of the data input for a **LEVEL TWO (Detailed)** analysis involves making building-specific estimates which override the default values used in a **LEVEL ONE (Minimum Data)** analysis.

For a **LEVEL TWO (Detailed)** analysis, there are five data tables where default information may be overridden by the user with building-specific information:

1.   **Building Depth-Damage Function**

2.   **Contents Depth-Damage Function**

3.   **Displacement Time**

4.   **Functional Downtime**

5.   **Mitigation Project Effectiveness**

This chapter reviews these five data tables and provides guidance about making building-specific estimates.

LEVEL TWO DATA: BUILDING DEPTH-DAMAGE FUNCTION

The **Building Depth-Damage Function (DDF)** indicates a building's vulnerability to flood damage by showing the expected levels of damage, both as a percentage of building replacement value and as dollars of damage for each flood depth. The **Building Depth-Damage Function** is the damage estimated to occur to a building at each flood depth.
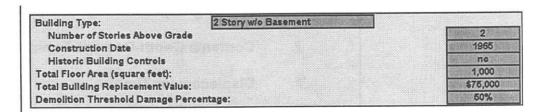
The following three sections, **Reference Information from Level One Data**, **Building Depth-Damage Function**, and **Comments: Building DDF**, all pertain to the **Building Depth-Damage Function**.

The **Building Depth-Damage Function** section of the LEVEL TWO **(Detailed)** benefit-cost analysis is reached via the menu tree:
Level Two Data | Building Depth-Damage Function

REFERENCE INFORMATION
FROM LEVEL ONE DATA

Carry Over Information

Building Type:	2 Story w/o Basement	
Number of Stories Above Grade		2
Construction Date		1965
Historic Building Controls		no
Total Floor Area (square feet):		1,000
Total Building Replacement Value:		$75,000
Demolition Threshold Damage Percentage:		50%

PURPLE Blocks (Carry Over). Information from the LEVEL ONE **Data** page is displayed to identify the building under consideration and to provide reference information and guidance for the LEVEL TWO **(Detailed)** evaluation.

BUILDING DEPTH-DAMAGE FUNCTION (DDF)

Building Depth-Damage Table

Flood Depth (feet)	ESTIMATED BUILDING DAMAGE			
	Default DDF (%)	User-Entered DDF (%)	Modified DDF (%)	Modified DDF ($)
-2	0		0	$0
-1	0		0	$0
0	5		5	$3,750
1	9		9	$6,750
2	13		13	$9,750
3	18		18	$13,500
4	20		20	$15,000
5	22		22	$16,500

There are five columns in the **Building Depth-Damage Table**. The first column shows the range of flood depths considered, from -2 to 18 feet. The next three columns contain damage estimates in percentages of the building's replacement value: **Default DDF**, **User-Entered DDF**, and **Modified DDF** (to account for the demolition damage threshold percentage). The fifth column converts the **Modified DDF** from percentages of damage into dollars of damage.

Default Building DDF

ORANGE Blocks (Default). The **Default Building DDF** estimates shown are based on the building type selected earlier and on Federal Insurance Administration (FIA) data. FIA data on hundreds of thousands of flood damage claims are categorized into six classes of structures. These FIA data are predominantly, but not entirely, for residential buildings.

In conformance with the FIA depth-damage data, the depth-damage table runs from -2 to 18 feet, with all depths relative to the **Zero Flood Depth Elevation** of the building (i.e., the top of the first finished floor). Damage data is included for depths below 0 feet because damage occurs at these flood levels for buildings with basements.

The default depth-damage estimates have several limitations:

1. Only six classes of buildings are included.

2. No distinction is made between different types of construction. For example, one-story wood frame and masonry buildings are grouped in the same class.

3. No distinction is made for differences in construction practices or age of structures.

4.   FIA depth-damage estimates include all claims including flood damage due to high velocity flows, ice or debris flows, or erosion and soil/foundation failures. However, the preponderance of claims are due to water depth only and thus these depth-damage estimates approximate water depth only damages.

5.   Damage estimates do not consider the flood duration.

6.   Depth-damage data at high flood depths are based on many fewer claims than at lower flood depths and thus may be less reliable.

For the above reasons, the **Default DDF** data should be regarded as a useful approximation to actual expected water depth-damages, but certainly not as absolute truth for all circumstances.

**FIA
Depth-Damage
Table**

The following table displays the default depth-damage estimates by flood depth for the six classes of building types plus the "other" classification included in the program. These estimates are from the FIA flood damage claim data; values at a few depths have been interpolated between FIA data points.

FIA DEPTH-DAMAGE DATA

Building Type / Flood Depth	1 Story, without Basement	2 Story, without Basement	Split Level without Basement	1 or 2 Story, with Basement	Split Level, with Basement	Mobile Home	Other
-2	0	0	0	4	3	0	0
-1	0	0	0	8	5	0	0
0	9	5	3	11	6	8	0
1	14	9	9	15	16	44	0
2	22	13	13	20	19	63	0
3	27	18	25	23	22	73	0
4	29	20	27	28	27	78	0
5	30	22	28	33	32	80	0
6	40	24	33	38	35	81	0
7	43	26	34	44	36	82	0
8	44	29	41	49	44	82	0
9	45	33	43	51	48	82	0
10	46	38	45	53	50	82	0
11	47	38	46	55	52	82	0
12	48	38	47	57	54	82	0
13	49	38	47	59	56	82	0
14	50	38	47	60	58	82	0
15	50	38	47	60	58	82	0
16	50	38	47	60	58	82	0
17	50	38	47	60	58	82	0
18	50	38	47	60	58	82	0

User-Entered Building DDF

BLUE Blocks (Override Default). If the **Default DDF** does not accurately reflect the specific building under evaluation, users may enter more appropriate estimates based on engineering judgement and common sense. If the **OTHER** building type is selected, then no default values are provided and the user **MUST** enter building-specific estimates. Whenever a user enters a depth-damage estimate, the program uses these values rather than the default values, although the default values are displayed for comparison to the user-entered values.

If building damage data at one observed flood depth are available, this value may be used to calibrate the user-entered building DDF. The percent damage at this flood depth can be set to agree with the actual damages, and damages at other flood depths can be smoothly adjusted to be consistent with the observed damage data point. However, it is important to note that the damages in a single flood may or may not be representative of future expected damages, depending on whether or not unusual circumstances affected the observed damages.

Overriding the default depth-damage estimates is perfectly acceptable, indeed it is required in order to get a valid benefit-cost analysis whenever the default estimates do not accurately reflect the building under evaluation. For example, if a building is unusually resistant or unusually vulnerable to flood damage this information should be reflected in the user-entered depth-damage function.

Also, the default depth-damage estimates consider predominantly water depth. If high velocity flows, ice or debris-induced damage, erosion and soil/foundation failure, or unusually long-duration flooding are likely, then default depth-damage estimates **MUST** be adjusted accordingly.

> **A user-entered Building Depth-Damage Function MUST be entered whenever high velocity flows, ice or debris-induced damage, erosion and soil/foundation failure, or unusually long-duration flooding are likely.**

Modified Building DDF

YELLOW Blocks (Results). The **Modified DDF (%)** takes into account the demolition threshold damage percentage entered on the **LEVEL ONE Data** page and adjusts the DDF accordingly. For example, if the demolition percentage is 40% then all damages at or above 40% are assumed to be 100%, because the building would be expected to be demolished as a total loss at that level of damage.

YELLOW Blocks (Results). The depth-damage percentages of the **Modified DDF (%)** are converted to dollars in the final column of the depth-damage table.

COMMENTS: BUILDING DDF

Comments   **PINK Block (Information Only).** This comment box may be used to record specific information about the building which affects its vulnerability to flood damage or any other information or assumptions which affect the user-entered depth-damage estimates (such as floods with debris or long duration flooding). Additionally, if **OTHER** was selected as the building type, a description of the building and its estimated depth-damage function should be entered here.