

5/25/94

## Errata for FACI DAP Theory and User's Manual P-i Diagrams'

( VERSION 1.2 )

| Page *                                     | Description   | Existing Statement or Parameter                            | Corrected Statement or Parameter  |
|--|---|--|---|
| 23   | Description for parameter(c)                                    | Compression on Block Depth (c)                             | Distance of maximum tension fiber below neutral axis (c)                                      |
| 31a  | Description for Modulus of Elasticity                           | Young's Modulus  | Young's Modulus (E)   |
| 35   | Description for Parameter (b <sub>1</sub> )                     | Section Width (used for all Section Property Calculations) | Width of Area Supported by Component which is Loaded by Blast                                 |
| 42a and 42b                                | Pbar and Ibar Numerator   | b  | b <sub>1</sub>  |
| 44   | Pbar and Ibar Denominator                                       | I  | I <sub>yy</sub>   |
| 46   | Ibar Numerator  | I <sub>xx</sub>  | I   |
| 47   | Description of Parameter (t)                                    | (Usually 1.25" for CMU, 0.75" for Thickness)               | (Usually 1.25" for CMU, 0.75" for Masonry Block)  |
| 50   | Pbar and Ibar Denominator                                       | $\sigma_y$   | $f_t$   |
| 50   | Pbar Denominator  | w  | w <sub>L</sub>  |
| 52   | Ibar Denominator ←  | <del>NUMERATOR</del> L                                     | Delete this for Ibar term   |
| 53   | Add Description for Parameter (c)                               | None   | Refer to <b>Two-Way Reinforced Concrete Slab Descriptions</b> for explanation of Parameter(c) |
| 57 and 54(UM)                              | Example Value for Moment of Inertia (I) in last column of Table | 69 in <sup>4</sup>   | 37.4 in <sup>4</sup>  |
| 59 and 55(UM)                              | Example Value for Moment of Inertia (I) in last column of Table | 64.8 in <sup>4</sup>                                       | 45 in <sup>4</sup>  |
| 51, 59, 54(UM), 55(UM)                     | Notes below Table   | The formula above assumes one-fourth...                    | The fommla above assumes one-half...  |
| 57, 59, 61, 63, 54(UM), 56(UM), 57, 55(UM) | Example Calculation for Parameter (W) at bottom of page         | $W = [...] / (L)$  | $W = [...] (L)$   |
| 19, 21, 23, 25, 29, 37, 51, 53             | Footnotes at bottom of Table                                    | SEE...At Bud of Component Descriptions                     | SEE...On page 59 of User's Manual   |

\* All page numbers refer to Theory Manual unless followed by (UM) which designates User's Manual

CEMP-ET

DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
Washington, D.C. 20314-1000

ETL 1110-3-434

Engineer Technical  
Letter 1110-3-434

16 August 1993

Engineering and Design  
DESIGN AND ANALYSIS OF CONVENTIONAL STRUCTURES  
SUBJECTED TO BLAST LOADING

1. Purpose. This letter announces the availability of the Facility and Component Explosion Damage Assessment Program (FACEDAP). This computer program can be used for the preliminary design of new or the analysis of existing buildings of conventional construction that may be subjected to the effects of blast overpressure from terrorist high explosive devices.

2. Applicability This letter applies to all HQUSACE elements, major subordinate commands, districts, and field operating activities (FoA) having military design and construction responsibility.

3. References. References can be obtained from the U.S. Army Engineer District, Omaha, ATTN: CEMRO-ED-ST, 215 North 17th Street, Omaha, Nebraska 68102-4978.

a. Protective Design-Mandatory Center of Expertise technical report, PDC-TR 91-6, "Blast Analysis Manual," July 1991.

b. "Security Engineering Manual," January 1990.

4. Discussion,

a. **FACEDAP** is an automated version (with modifications) of the work documented within the Blast Analysis Manual (reference 3a.). The program has 24 resident structural components and a database of 13 different conventional facilities. It uses a series of horizontal and vertical menus along with spreadsheets to allow the user to easily enter the information necessary to perform a facility damage assessment due to the overpressure effects from an external explosion. For any given problem, a facility from the existing database can be modified or a facility can be developed from scratch. A facility can be made up of only one or all of the different structural components. The program can be used to perform parametric studies in two different ways. For an existing facility, it can be used to determine the necessary standoff distance for an explosive charge weight in order to achieve the required level of protection (LOP) For facilities in the design stage, it can be used during the preliminary design to determine hardening requirements for a given standoff distance and explosive charge weight in order to achieve the required LOP. The LOP required by a facility is determined using the process contained in the Security Engineering Manual (reference 3b.).

This ETL supersedes ETL 1110-3-434, dated 30 November 1991.

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b. The FACEDAP program uses a relatively accurate procedure for determining the vulnerability of conventional structures to external explosive threats. Facility vulnerability, in terms of the percentage of damage to the overall structure caused by an external explosion, is calculated in a two-step procedure. In the first step, damage to each structural component in the facility (i.e., beams, columns, wall panels) is calculated using equations fit through curves in a graphical procedure (pressure-impulse diagrams) which defines four different damage levels (0, 30, 60, and 100 percent damage). Each damage level corresponds to a LOP. The correspondence of damage level to LOP is zero percent damage equals a high LOP, 30 percent damage equals a medium LOP, 60 percent damage equals a low LOP, and 100 percent damage equals no LOP, or collapse of the facility. In the second step of the procedure, **the calculated** damage to each structural component is first "weighted" by a weighing factor. The weighted component damage is then summed, and this **sum** is divided by the value corresponding to a total failure of all structural components to determine the percentage of facility damage. Cascading failure, where failure of a supporting component causes failure of all supported components, is determined in the summation algorithm. Facility reparability and reusability, and the LOP provided by the building are also determined in similar **summation** processes.

5. Action to be Taken. The analytical process contained in FACEDAP **will** be used to determine the level of **protection** provided by the structural system of a conventional facility subject to **external** detonation of terrorist explosive devices. Copies of the program and supporting documentation can be obtained from the U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-IM-DS, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199, telephone 601-634-2300. The program will operate on an IBM compatible personal computer having a minimum of 512k RAM, a CGA color or monochrome video monitor, one 360k floppy disk drive, and a 20 Mb hard disk. FACEDAP supports most printers for hard copy output. For technical questions concerning FACEDAP, contact the U.S. Army Corps of Engineers, Protective Design-Mandatory Center of Expertise, ATTN: CEMRO-ED-ST, 215 North 17th Street, Omaha, Nebraska 68102-4978, telephone 402-221-3151.

6. Implementation. This letter will have routine application as defined in paragraph **6c**, ER 1110-345-100.

FOR THE DIRECTOR OF MILITARY PROGRAMS:

  
RICHARD C. ARMSTRONG, P.E.  
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Protective Design - Mandatory Center of Expertise

Facility And Component Explosive  
Damage Assessment Program

**(FACEDAP)**

Version 1.2

User's Manual  
Theory Manual  
Programmer's Manual

**SwRI Project No. 06-5145-001**  
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Prepared for:

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