OFFICE, CHIEF OF ENGINEERS
CONTRACT NO.

ENGINEERING STUDY
RESISTANT DESIGN
BUILDING

PREP
AMMANN
CONSULTING
NEW

Best Available Copy
APPENDIX H

DEPARTMENT OF THE ARMY
DA 49-129-ENG-317

STUDY OF ATOMIC BLAST
IGNITION FOR SEVERAL
G TYPES

PREPARED BY
WHITNEY
ENGINEERING
NEW YORK, N.Y.
DY OF ATOMIC BLAST
IGN FOR SEVERAL
NG TYPES

PREPARED BY
N & WHITNEY
ILING ENGINEERS
EW YORK, N.Y.

RAWING LIST

<table>
<thead>
<tr>
<th>DWG NO</th>
<th>PROTECTIVE CONSTRUCTION</th>
<th>BURIED, RECTANGULAR</th>
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<tbody>
<tr>
<td>SHEETS</td>
<td>THRU E OF 6</td>
<td>800 PSI BLAST RESISTANT</td>
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<td>SHEET</td>
<td>OF 7</td>
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<td>THRU E OF 8</td>
<td>200 PSI BLAST RESISTANT</td>
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GENERAL NOTES

ENGINEERING STUDY OF ATOMIC BLAST RESISTANT DESIGN FOR SEVERAL
WEAPONS SYSTEMS. THE RESULTS OF A STUDY TO DETERMINE THE PRAXICABILITY
OF ESTIMATED CONSTRUCTION COST FOR A RANGE OF BLAST PRESSURE
WAREHOUSE DRAWINGS ARE BASED UPON THE HARDENING OF
GING THE INTERIOR CONFIGURATIONS. THE INTERIOR CONFIGURATIONS OF
RECTANGULAR, DOUBLE AND DOME, ARE BASED UPON DIMENSIONS
OTHERWISE NOTED IN THE REPORT WERE BASED UPON THE PRELIMINARY
345-413 THROUGH 421, "DESIGN OF STRUCTURES TO RESIST THE
INTENDED TO DEPICT THE RESULTS OF THE DESIGN STUDY ONLY THEY
TO REPRESENT RECOMMENDED DESIGN. HOWEVER, THEY CAN BE USED
DEVELOPMENT OF REQUIRED DESIGNS. IN THE DESIGN OF EXPOSED ABOVE
AND ROOF WERE DETERMINED BY BLAST RESISTANCE REQUIREMENTS
Adequate shielding FROM FALLOUT ISOLATION. HOWEVER, THE EARTH
AREAS IN THE EXPOSED ABOVE GROUND STRUCTURES HAVE BEEN
RADIATION AS NOTED ON THE DRAWINGS AND THEREFORE AFFORD
PROVISION OF ADEQUATE THICKNESS IN THE WALLS AND ROOF OF THE
WINGS TO PROVIDE THE REQUIRED SHIELDING FROM FALLOUT RADIATION
NOT INCLUDED IN THIS CONTRACT

2
ELEVATION OF MAIN DOORS
SCALE 1'-0"

SECTION B-B
SCALE 1'-0"

FIRST FLOOR PLAN - ARCHITECTURAL
SCALE 1'-0"
<table>
<thead>
<tr>
<th>#</th>
<th>Material</th>
<th>Size</th>
<th>Class</th>
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<tr>
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<td>7'-6&quot;</td>
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<td>2</td>
<td>Wood</td>
<td>7'-6&quot;</td>
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<td>3</td>
<td>Wood</td>
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<tr>
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**Exterior**

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<tr>
<td>2</td>
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<tr>
<td>3</td>
<td>Wood</td>
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<td>CLEAR</td>
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<tr>
<td>4</td>
<td>Wood</td>
<td>5'-10&quot;</td>
<td>CLEAR</td>
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<tr>
<td>5</td>
<td>Wood</td>
<td>5'-10&quot;</td>
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*SECOND FLOOR PLAN - ARCHITECT*
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<thead>
<tr>
<th>MATERIAL</th>
<th>INTERIOR</th>
<th>GLASS</th>
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<tbody>
<tr>
<td>A  WOOD</td>
<td>3'-6&quot;-6'-0&quot;</td>
<td>CLEAR</td>
</tr>
<tr>
<td>B  WOOD</td>
<td>3'-6&quot;-6'-0&quot;</td>
<td>CLEAR</td>
</tr>
<tr>
<td>C  WOOD</td>
<td>3'-6&quot;-6'-0&quot;</td>
<td>CLEAR</td>
</tr>
<tr>
<td>D  KALAMIN</td>
<td>5'-0&quot;-6'-0&quot;</td>
<td>CLEAR WIRE</td>
</tr>
<tr>
<td>E  KALAMIN</td>
<td>5'-0&quot;-6'-0&quot;</td>
<td>CLEAR WIRE</td>
</tr>
<tr>
<td>F  KALAMIN</td>
<td>5'-0&quot;-6'-0&quot;</td>
<td>CLEAR WIRE</td>
</tr>
<tr>
<td>G  METAL</td>
<td>5'-0&quot;-6'-0&quot;</td>
<td>CLEAR WIRE</td>
</tr>
<tr>
<td>H  KALAMIN</td>
<td>5'-0&quot;-6'-0&quot;</td>
<td>CLEAR WIRE</td>
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<thead>
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<tr>
<td>A  WOOD</td>
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<td>CLEAR</td>
</tr>
<tr>
<td>B  WOOD</td>
<td>3'-6&quot;-6'-0&quot;</td>
<td>CLEAR</td>
</tr>
<tr>
<td>C  WOOD</td>
<td>6'-7'-7'-0&quot;</td>
<td>CLEAR WIRE</td>
</tr>
<tr>
<td>D  WOOD</td>
<td>6'-7'-7'-0&quot;</td>
<td>CLEAR WIRE</td>
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</table>

SECOND FLOOR PLAN
Design Conditions

Conformance with OCE manual "Design of Structures for Protection from the Effects of Atomic Weapons"

Design Blast Wave

Base number pressure - 750 psi, 7000 sec. blast

Blast Loading on Roof and Walls

Blast Loading - 500 psi, 7000 sec. blast

Nuclear Explosion Protection

Piping and equipment swing to 20 ft. for a 200 T explosion at any position which will produce a peak blast pressure of 100 psi. Full 20 ft. swing for a 200 T explosion.

Strength of Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Biaxial</th>
<th>Biaxial Design</th>
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</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>6,000 psi</td>
<td>4,000 psi</td>
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<tr>
<td>Steel</td>
<td>40,000 psi</td>
<td>50,000 psi</td>
</tr>
<tr>
<td>Reinforced steel</td>
<td>40,000 psi</td>
<td>50,000 psi</td>
</tr>
<tr>
<td>Structural steel</td>
<td>60,000 psi</td>
<td>80,000 psi</td>
</tr>
</tbody>
</table>

Rated capacity of equipment

Allowable stresses and deflections

Vibros, vibrations and deflections may be determined by design and analysis of blast load and equipment. Allowable stresses for maximum safe deflection under design over 500 psi.

General Notes

1. The following notes are not shown and shall be determined to meet user requirements.

- Structural components
- Mechanical and electrical equipment
- Air rights and limitations on facilities

2. A. All items may be provided if required for vehicles.

3. Structure may be located 1.5 miles from all blast sources.

SECTION 0-0
DESIGN CONDITIONS

Design Procedure

- A review of the manual "Design of Structures to Protect from the Effects of Atomic Bombing"

Design Basis

- Design basis: S-12

Blast Loading on Roof

- Blast loading on roof: 80 psi

Blast Loading on walls

- Blast loading on walls: 80 psi

Nuclear Radiation Protection for Shelter Area

- From ground and vertical components of radiation for a shelter are designed to ensure maximum protection for personnel.

Strength of Materials

- Table of strengths and blast design loads

Allowable Stresses and Deflections

- Allowable stresses and deflections are designed to ensure deformation under blast loads and to protect against collapse or failure of the structure.

General Notes

- The following notes are not shown but are for reference.

- Notes for additional equipment

- Notes for design and construction tolerances

- Notes for any other important design details

- Notes for any other important construction details

- Notes may be added in future if any changes are made.
**Design Conditions**

- **Design Procedure**
  In accordance with OCE Manual "Design of Structures for Protection From the Effects of Atomic Weapons".

- **Design Blast Wave**
  Peak in near pressure: 5.5tons. Duration: 0.05 sec.

- **Blast Loading on Dome Surface**
  380 KPSI.

- **Nuclear Radiation Protection**
  Dome geometry and sections attenuated to 90% of a blast pressure of 25 tons. The blast pressure prior to blast.

- **Strength of Materials**
  Tensile strength: 0.050 ksi. Yield point: 0.025 ksi. Design strength: 0.025 ksi. Strength of steel: 0.025 ksi. Standard steel: 0.025 ksi. ASTM A505.

- **Note**
  Shear reinforcement not shown.

**SECTION B-B**

**Floor Slab and Foundation Plan**
Design Conditions

Design Blast Wave
Post-impact pressure: 1000 psi; Duration: 0.64 sec

Blast Loading on Dome Surface
Post-impact pressure: 35 psi

Structural Protection
Structural loading and limitations determined to 35 psi for an 80 Kt weapon at any position which will produce a peak blast pressure equal to 25 psi

Material Strengths

<table>
<thead>
<tr>
<th>Material</th>
<th>Tensile Strength</th>
<th>Yield Strength</th>
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<tbody>
<tr>
<td>Concrete</td>
<td>6000 psi</td>
<td>46000 psi</td>
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<tr>
<td>Reinforcing Steel</td>
<td>50,000 psi</td>
<td>22,000 psi</td>
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<tr>
<td>Steel</td>
<td>60,000 psi</td>
<td>46,000 psi</td>
</tr>
</tbody>
</table>

Allowable Stresses and Deflections

The foundation and entrance are designed for plastic deformation under design blast load. Steel, masonry, and concrete structures are designed for maximum plastic deformation under design blast load.

General Notes

1. The following features are not shown and shall be determined in surfice requirements:
   a. Interiors
   b. Mechanical and electrical equipment
   c. Air locks and decontamination facilities

2. Access ramp shall be provided if required for vehicles.
3. Thermal protection is to be applied to all exterior doors.
4. Structure shall be covered to balance out and fill if desired

Floor Slab and Foundation Plan

Amblain & Whitney
Department of the Army
Engineering Division
111 W. 34th St., New York, N.Y.

Protective Construction
General Purpose Structure
Earth-Covered Dome
100 PSI Blast Resistant

80-10-038

A5
FLOOR SLAB AND FOUNDATION PLAN
**DESIGN CONDITIONS**

**Design Procedure**
In accordance with OCE manual, Design of Structures for Protection against Effects of Atomic Weapons.

**Design Blast Wave**

- Peak overpressure: 100 psf. Duration: 0.64 ms.
- Blast Loading on Exterior Surface
  - Peak pressure: 100 psf. Duration: 0.64 ms.
- Nuclear Radiation Protection
  - All materials are chosen to withstand at least 2 x 10^6 rad or any known level of radiation. A minimum 0.01 in. thick face sheet is required.

**Strength of Materials**

- **Static**
  - Concrete, C2: 3000 psi
  - Reinforced concrete, C10-40: 6000 psi
  - Steel: 45,000 psi

- **Blast Design**
  - Concrete, C2: 15,000 psi
  - Reinforced concrete, C10-40: 30,000 psi
  - Steel: 60,000 psi

**Allowable Stresses and Deflections**

- All structures are designed to withstand the blast loads and nuclear radiation effects.

**General Notes**

1. The following features are not shown and shall be determined by the user's requirements:
   - **Interior partitions**
   - Mechanical and electrical equipment
   - Access and contamination features
   - Access ramps may be provided as needed.
   - Access doors may be provided if required for vehicles over 5 tons to be moved in or out.

**SECTION A-A**

- **Note:** For cut and fill, refer to official plans and specifications.

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**PROTECTIVE CONSTRUCTION**

**GENERAL PURPOSE STRUCTURE**

**BURIED RECTANGULAR**

**100 PSI BLAST RESISTANT**

**AMMANN & WHITNEY**
DEPARTMENT OF THE ARMY

**REMARKS**

- PROTECTIVE CONSTRUCTION
- GENERAL PURPOSE STRUCTURE
- BURIED RECTANGULAR
- 100 PSI BLAST RESISTANT
Design Conditions

Design Procedure
In accordance with "AE manual. Design of Structures for Protection from the Effects of Atomic Weapons."

Design Blast Wave
Peak Instant Pressure: 16,000 psi, Duration: 0.1 sec.

Blast Loading on Exterior Surfaces
Peak pressure: 200 psi, Duration: 0.1 sec.

Nuclear Radiation Protection
After ground fallout, is assumed to be 5% for a 1-kiloton weapon of any orientation which will produce a peak blast pressure equal to 200 psi.

Strength of Materials

<table>
<thead>
<tr>
<th>State</th>
<th>Stress</th>
<th>Design</th>
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<td>5-year mean stress</td>
<td>8,000 psi</td>
<td>16,000 psi</td>
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<tr>
<td>Concrete</td>
<td>20 ksi</td>
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<tr>
<td>Reinforced Concrete</td>
<td>4 ksi</td>
<td>5 ksi</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>50 ksi</td>
<td>4 ksi</td>
</tr>
<tr>
<td>Welded capacity</td>
<td>50 ksi</td>
<td></td>
</tr>
</tbody>
</table>

Allowable Stress and Deflections
Buildings, floors, and other appurtenances are designed for blast deflections and are to be designed for maximum static deflections from design criteria.

General Notes

1. The following features are shown and shall be determined to suit site requirements:
   - Interior partitioning
   - Mechanical and electrical equipment
   - Air intake and decontamination facilities

2. Access may be made as required.

3. Access for maintenance, if provided, is required for vehicles.

4. Access features to be showing on exterior doors.

SECTION B-B

Design by AMBACH & WHITNEY

40-79-04 PROTECTIVE CONSTRUCTION

GENERAL PURPOSE STRUCTURE

BURIED RECTANGULAR

200 PSI BLAST RESISTANT
Design Conditions

- Buildings and other structures shall be designed and constructed to withstand the effects of blast loads.
- Design Blast Wipeout Load: 50 psi over a minimum area of 500 square feet.
- Blast Loading on Exterior Surfaces shall be consistent with the Design Blast Wipeout Load.
- Nuclear Radiation Protection must be designed into the structure to provide adequate shielding for personnel and equipment.
- Strength of Materials:
  - Static Design:
    - Concrete: 4,000 psi
    - Steel: 50 ksi
  - Dynamic Design:
    - Concrete: 3,000 psi
    - Steel: 50 ksi
- Allowable Stresses and Deflections:
  - Design stresses and deflections shall be determined by the designer.
  - Deflection of the structure shall not exceed 0.003 of the span.
- General Notes:
  - All dimensions shown are in inches and shall be used in conjunction with the project requirements.
  - The designer shall be responsible for the overall design and construction of the structure.

SECTION C-C

SCALE 1/8"=1'-0"
DESIGN CONDITIONS

Usage Procedure
It is recommended that the designer of Blast Resist structures be consulted from the effects of active operations.

Design Blast Wave
The design blast wave is considered in the analysis of the structure.

Blast Loading on Exterior Surface
The analysis is based on the loading due to the blast wave.

Nuclear Radiation Protection
The structure is designed to withstand the effects of nuclear radiation.

Strength of Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Static</th>
<th>Blast</th>
</tr>
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<tr>
<td>Steel</td>
<td>5 tons</td>
<td>3 tons</td>
</tr>
<tr>
<td>Concrete</td>
<td>7 tons</td>
<td>4 tons</td>
</tr>
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</table>

Allowable Stress and Deflections
The structure is designed to allow for allowable stress and deflections as per the design code and regulations.

General Notes
The structure is designed to meet all applicable codes and regulations.
FLOOR SLAB AND FOUNDATION PLAN
SCALE 1/10'-0"

DETAIL OF FOOTING
SCALE 1/10'-0"

SECTION C-C
SCALE 1/10'-0"
Design Procedure

In accordance with DOD manual "Design of Structures for Protection from the Effects of Atomic Explosions."

Design Blast Wave

Peak Positive Pressure = 1000 psi, Duration = 0.04 sec.

Blast Loading on Exterior Surface

Interior Pressure = 0 psi

Nuclear Radiation Protection

Total gamma and neutron attenuation is 50 for a 1/20 x 7 weapon at the position which will produce a peak blast pressure of 20 to 100 psi.

Strength of Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Design Stress Capacity</th>
<th>Blast Design Stress Capacity</th>
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<tr>
<td></td>
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<tr>
<td>Steel</td>
<td>5000 psi</td>
<td>8000 psi</td>
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<tr>
<td>Reinforced Concrete</td>
<td>3000 psi</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Reinforced Concrete (Grade ASTM A305-50T)</td>
<td>3000 psi</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Structural Steel Plate (ASTM A7-52)</td>
<td>36,000 psi</td>
<td>48,000 psi</td>
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</table>

Allowable Stress and Definitions

The allowable stresses used in the design are for design blast waves, and material strengths are for 100 psi blast pressure. Design blast loads are 100 psi.

General Notes

1. The following features are not shown and shall be determined to best use requirements:
   a. Structural modifications
   b. Mechanical and electrical equipment
   c. Air locks and demobilization facilities.
2. Access doors may be varied as required.
3. Access ramps may be provided if required for vehicles.
4. Thermal protection is to be 1000 psi at interior frame.
Design Conditions

Design Procedure

- Per ACO 15-220
- Design Procedure
- Per ACO 15-220

Design Basis

- Per ACO 15-220
- Design Procedure

Blast Loading on Exterior Surfaces

- Per ACO 15-220
- Design Procedure

Nuclear Radiation Protection

- Per ACO 15-220
- Design Procedure

Strength of Materials

- Per ACO 15-220
- Design Procedure

<table>
<thead>
<tr>
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<th>Static</th>
<th>Blast Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>5,000</td>
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</tr>
<tr>
<td>Steel</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Timber</td>
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<td>2,000</td>
</tr>
<tr>
<td>Wood</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>30,000</td>
<td>30,000</td>
</tr>
</tbody>
</table>

Allowable Stresses and Deflections

- Per ACO 15-220
- Design Procedure

General Notes

- Per ACO 15-220
- Design Procedure

лен

- Per ACO 15-220
- Design Procedure

2. A copy of this document shall be provided to the concerned authorities.
PROTECTIVE CONSTRUCTION
GENERAL PURPOSE STRUCTURE
BURIED CONCRETE (BLOO)
100 PSI BLAST RESISTANT

2
### Design Parameters

- **Height:** 10 ft
- **Wall Thickness:** 8 in
- **Door Opening:** 3 ft x 5 ft

### Material Specifications

<table>
<thead>
<tr>
<th>Strength of Materials</th>
<th>Stress</th>
<th>Burst Design</th>
</tr>
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<tr>
<td><strong>Concrete</strong></td>
<td>4,000 psi</td>
<td>8,000 psi</td>
</tr>
<tr>
<td><strong>Reinforcing Bars</strong></td>
<td>5,000 psi</td>
<td>10,000 psi</td>
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</table>

### Assembly Processes and Deflections

- **Concrete:** A system of reinforcement was designed to provide the necessary strength for the structure under blast load. The formwork was used to ensure the correct shape and dimensions of the concrete.

### General Notes

- The following notes are not shown and can be determined from the code requirements.

**Material:**

- Concrete: C30/C30
- Reinforcing Bar: 1/2" steel

**Area:**

- All areas shown are to be verified.

**Dimensions:**

- All dimensions shown are to be verified.

**Details:**

- The details shown are not to be relied upon.

**Drawing Number:**

- 80-86-07

**Date:**

- Sheet 1 of 2

**Date:**

- Sheet 1 of 2