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---TECHNICAL REPORT---

THE NATION'S LABORATORY FOR ADVANCED AUTOMOTIVE TECHNOLOGY

No. 13714



M-2 BAILEY BRIDGE (M2BB)
PALLETIZATION AND CONTAINERIZATION
LOAD CONFIGURATION STUDY

March, 97

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By Anh V. Nguyen

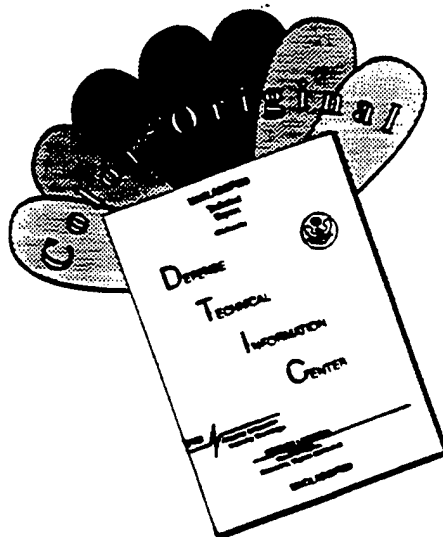
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13. ABSTRACT (Maximum 200 words) This report addresses the Palletized Loading System (PLS) Flatrack and ISO Container Load Configurations for the M-2 Bailey Bridge (M2BB) Basic Set and Erection Equipment Set. The M2BB Basic Set contains enough components to install two 80-foot double-single (DS) bridges with launching nose or one 130-foot double-double (DD) bridge with launching nose. The optimum arrangement of M2BB components on PLS flatracks or ISO containers was determined through the use Computer Aided Modeling (CAM) of the M2BB components, PLS flatrack, and ISO container. The results of the study are that components of the M2BB Basic Set and Erection Equipment Set can be loaded on two M1077 PLS flatracks and eighteen M1 PLS flatracks or in two 40-foot ISO containers and eighteen 20-foot ISO containers. Some of the palletized and containerized loads are well below the payload limits; and the flatracks and containers for these loads still have room for the overhead bracing supports and components of the M2BB Conversion Set and Cable Reinforcement Set. If these components are required, there will be no need for extra PLS flatracks or ISO containers. The resulting load configurations must be verified by tests before their use. Tiedown procedures for palletization and containerization should be documented in detail during testing. These documented tiedown procedures should be incorporated into the M-2 Bailey Bridge manual.				
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TABLE OF CONTENTS

1. SUMMARY	1
2. INTRODUCTION	1
3. METHODS, ASSUMPTIONS, AND PROCEDURES	2
3.1. Use of PLS Flatracks for the M2BB Palletization	2
3.2. Use of ISO Containers for the M2BB Containerization	2
3.3. Criteria for Determination of Load Configurations	2
3.4. Use of Computer Aided Modeling (CAM)	3
4. RESULTS AND DISCUSSION	3
4.1. M2BB Palletization and Containerization Results	3
4.2. M2BB Palletization and Containerization Discussion	4
4.3. Tiedown Procedures Discussion	5
5. CONCLUSION AND RECOMMENDATIONS	6
6. DISTRIBUTION LIST	7
7. APPENDIXES	9
APPENDIX 1: M-2 BAILEY BRIDGE EXISTING TRUCK LOADS IN ACCORDANCE WITH FM 5-277	
APPENDIX 2: COMPONENTS OF A M-2 BAILEY BRIDGE BASIC SET	
APPENDIX 3: COMPONENTS OF A M-2 BAILEY BRIDGE ERECTION EQUIPMENT SET	
APPENDIX 4: M-2 BAILEY BRIDGE PALLETIZATION PLS FLATRACK LOAD CONFIGURATIONS	
APPENDIX 5: M-2 BAILEY BRIDGE CONTAINERIZATION ISO CONTAINER LOAD CONFIGURATIONS	
APPENDIX 6: M-2 BAILEY BRIDGE PALLETIZATION AND CONTAINERIZATION PAYLOAD DISTRIBUTION	
APPENDIX 7: MODELS OF M-2 BAILEY BRIDGE PALLETIZATION PLS FLATRACK LOAD CONFIGURATIONS	
APPENDIX 8: MODELS OF M-2 BAILEY BRIDGE CONTAINERIZATION ISO CONTAINER LOAD CONFIGURATIONS	

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1. SUMMARY

This report addresses the Palletized Loading System (PLS) Flatrack and International Organization for Standardization (ISO) Container Load Configurations for a M-2 Bailey Bridge (M2BB) Basic Set and a M2BB Erection Equipment Set. According to Field Manual 5-277, Bailey Bridge, the Basic Set contains enough components to install two 80-foot (24.4 m) double-truss single-story (DS) bridges with launching nose or one 130-foot (39.0 m) double-truss double-story (DD) bridge with launching nose. This study has determined that M2BB components of the Basic Set and the Erection equipment Set can be configured on two M1077 PLS flatracks and eighteen M1 ISO PLS flatracks or in two 40-foot ISO containers and eighteen 20-foot ISO containers. These results must be verified by tests before these configurations are adopted.

2. INTRODUCTION

The existing setup requires 25 5-ton dump trucks and 10 4-ton bolster trailers to transport one M2BB Basic Set and one M2BB Erection Equipment Set. The panel bridge engineer company has two platoons, each capable of transporting one 80-foot bridge, the most common bridge installed. The existing truck loads are shown on Appendix 1, M-2 Bailey Bridge Existing Truck Loads In Accordance With FM 5-277.

Total Army Analysis 2001 (TAA01) authorizes a total of 21 bridge companies. The US Army Engineer School (USAES) proposes that these remaining companies be configured into Multi-Role Bridge Companies (MRBCs) which would be capable of spanning both wet- and dry-gaps. To facilitate the move to the MRBC, a common transporter for both the Ribbon Bridge (RB) and the Heavy Dry Support Bridge (HDSB) is required. This transporter, the Common Bridge Transporter (CBT), is based on the Heavy Expanded Mobility Tactical Truck (HEMTT) chassis with PLS hardware attached.

A possible Bridge Company transition will be 10 Float Bridge Companies, 12 Medium Girder Bridge Companies, and 1 Bailey Bridge Company forming into 12 Multi-Role Bridge Companies. To support the transition, the US Army Aviation-Troop Command (ATCOM) and USAES requested that the Tank Automotive Research Development and Engineering Center (TARDEC) Support Bridge Team to examine the feasibility of placing components of the M2BB Basic Set and the M2BB Erection Equipment Set on M1 ISO PLS flatracks. Also, ATCOM tasked the TARDEC Support Bridge Team to investigate the feasibility of stacking these components in 20-foot ISO containers. The study of the M2BB Containerization would help

the US Army Depots and Combat Equipment Companies in storing the M2BB components.

3. METHODS, ASSUMPTIONS, AND PROCEDURES

3.1. Use of PLS Flatracks for the M2BB Palletization

It is desired to use M1 PLS flatracks to carry components of the M2BB Basic Set and the M2BB Erection Equipment Set. The M1 flatrack has a front upright and a rear upright, and its usable deck area is 2.44 x 5.64 m (96 x 222 in). The M2BB transom is 6.07 m (239 in) long, and it will not fit on this flatrack. Therefore, M1077 PLS flatracks will be used for the transoms and M1 flatracks will be used for all other components of the M2BB. The M1077 flatrack usable deck area is 2.26 x 5.77 m (89 x 227 in) with overhang allowed. The payload of a CBT with a M1 flatrack is approximately 7,120 kg (15,700 lb.)¹ while with a M1077 flatrack it is approximately 8,960 kg (19,750 lb.)¹.

3.2. Use of ISO Containers for the M2BB Containerization

The 20-foot ISO container with full opening side door is required to store M2BB components. Its internal dimensions are 5.78 m (231 in) long by 2.33 m (91.75 in) wide by 2.13 m (84 in) high. This container cannot carry the transoms since its internal length is shorter than the transom's length. Therefore, the 40-foot ISO container will be used for the transoms. The tare weight of the 20 foot ISO container is 2,040 kg (4,500 lb). Thus, the payload of a CBT with a 20-foot ISO container on a M1077 flatrack is approximately 6,920 kg (15,250 lb.)¹ It is noted that the CBT cannot handle 40-foot ISO containers.

3.3. Criteria for Determination of Load Configurations

The following criteria were considered in determining the load configurations:

- (a) The quantity of components of the M2BB Basic Set and the M2BB Erection Equipment Set listed in Appendix 2, Components of a M-2 Bailey Bridge Basic Set, and Appendix 3, Components of a M-2 Bailey Bridge Erection Equipment Set.

¹ These values assume the payload affects only the rear tandem axles. Higher payloads are possible if the Center of Gravity (CG) of the loaded flatrack is toward the front of the vehicle and the front tandem axles carry a portion of the load.

- (b) The height limit (from the ground) for all loadings is 2.44 m (96 in) for palletization. Flatracks with payloads above this height make hand loading and unloading difficult. The payload height for a 20-foot ISO container must be shorter than its internal height which is 2.13 m (84 in).
- (c) The maximum M1 and M1077 flatrack payloads when used with a CBT are 7,120 kg (15,700 lb) and 8,960 kg (19,750 lb) respectively. The maximum payload is 6,920 kg (15,250) for a 20-foot ISO container on a CBT.
- (d) Logical groupings of components required to reduce the number of unique flatrack loads and container loads.
- (e) Overall dimensions of M2BB components.
- (f) Stability of flatrack loads for general transport operations and for PLS uploading, downloading, and transloading operations.
- (g) Order in which M2BB components are required for erection of a Bailey bridge.
- (h) Keeping the vertical Center of Gravity (CG_z) of each load as low as possible.

3.4. Use of Computer Aided Modeling (CAM)

Computer Aided Modeling was used to assist in the analysis. Main components of the M2BB Basic Set were graphically modeled on a computer. Other components of the M2BB Basic Set and components of the Erection Equipment Set were logically grouped and modeled as blocks on a computer. Main components and blocks of components were then configured on PLS flatracks and ISO containers until the optimal solution was found.

4. RESULTS AND DISCUSSION

4.1. M2BB Palletization and Containerization Results

Given the above criteria, it was determined that the best solution for the palletization and containerization is the following seven load configurations:

- Configuration A: Erection Equipment Load
- Configuration B: Launching Load

Configuration C: Panel Load
Configuration D: Transom Load
Configuration E: Ramp/Others Load #1
Configuration F: Ramp/Others Load #2
Configuration G: Chess Load

These load configurations are illustrated in Appendix 4, M-2 Bailey Bridge Palletization PLS Flatrack Load Configurations, and Appendix 5, M-2 Bailey Bridge Containerization ISO Container Load Configurations.

Appendix 1 shows twenty-five 5-ton dump truck loads and ten 4-ton bolster trailer loads to transport enough components to install a 130-foot DD bridge with launching nose. This study recommends two M1077 flatrack loads, and eighteen M1 flatrack loads (palletization) or two 40-foot ISO container loads and eighteen 20-foot ISO container loads (containerization) for the same purpose.

4.2. M2BB Palletization and Containerization Discussion

- (a) Appendixes 4 and 5 include the heights of all load configurations. Load heights are kept well below the height limit which is 2.44 m (96 in) for palletization and 2.13 m (84 in) for containerization. The highest flatrack load shown in this study is 2.06 m (81.3 in) from the base of the flatrack. The highest container load is 1.78 m (70.0 in) from the container deck.
- (b) The estimated vertical Center of Gravity heights (CG_z) of the load configurations are listed in Appendixes 4 and 5. These CG estimates are only approximations as this study did not specifically address this issue.
- (c) Appendix 6, M-2 Bailey Bridge Palletization and Containerization Payload Distribution, lists the distributed load and gross dimension of each logical grouping on each flatrack or container. The CBT mobility is not degraded with the palletized loads as they are well below the payload limit of 7,120 kg (15,700 lb) and 8,960 kg (19,750 lb). The containerized loads for 20-foot ISO containers do not exceed the payload limit of 6,920 kg (15,250 lb). The CBT mobility is thus not degraded for these ISO containers. However, the CBT cannot handle the 40-foot ISO container. A compatible trailer-tractor combination must be used.
- (d) The transoms on Load Configuration D overhang 0.23 m (9 in) off the rear of the M1077 flatrack. This overhang is

within the requirement for CBT transportation.

- (e) The loading is optimized for launching. The load configuration designations follow the order in which flatracks are necessary to build the bridge (A and B first, and then C, and so on to G).
- (f) Components of the Erection Equipment Set are only loaded if required. When these components are not required, the remaining payloads for Configurations A and B can be used for the overhead-bracing supports and components of the Conversion Set and Cable Reinforcement Set if they are required. These remaining payloads are shown in Table 1, Remaining Payloads for Load Configurations A, B, C, and F.

Table 1:
Remaining Payloads for Load Configurations A, B, C, and F

Load Configuration	M1 Flatrack kg (lb)	20'-Container kg (lb)
A (w/o Erection Equipment)	4,390 (9,680)	4,200 (9,260)
B (w/o Erection Equipment)	2,420 (5,330)	2,230 (4,910)
C	2,950 (6,500)	2,755 (6,070)
F	2,565 (5,565)	2,330 (5,140)

- (g) The payloads of Configurations C and F are well below the payload limits for the M1 flatrack and for the 20-foot ISO container. The remaining payloads of these configurations are illustrated in Table 1. The unoccupied spaces for these remaining payloads are large enough to carry the overhead-bracing supports or components of the Conversion Set and the Cable Reinforcement Set if they are required.

4.3. Tiedown Procedures Discussion

The PLS flatracks and ISO containers have tiedown provisions which meet tiedown requirements specified in MIL-STD-209, Slings Tiedown Provisions for Lifting and Tying Down Military Equipment. These tiedown provisions must be used in tiedown procedures for the M2BB palletization and containerization. The tiedown rings and nylon straps equipped with PLS flatracks and ISO containers must be used for standard transport operations. Also, these procedures must ensure that each load is secured from side-to-side movement as well as end-to-end movement during both

transport operations and transloading operations. For transport operations other than on the CBT (overseas shipment, etc.) steel strapping should be used.

5. CONCLUSION AND RECOMMENDATIONS

The study revealed that the M2BB Palletization and the M2BB Containerization are feasible. This study is only a first step in placing components of M2BB Basic Set and the M2BB Erection Equipment Set on PLS flatracks and in ISO containers. The results of this study must be verified by tests. However, much of the initial ground work was done using CAM which should reduce the amount of actual testing required. The configurations suggested by the CAM should be used as a starting point with only minor modifications being required. Appendix 7, Models of M-2 Bailey Bridge Palletization PLS Flatrack Load Configurations, and Appendix 8, Models of M-2 Bailey Bridge Containerization ISO Container Load Configurations, illustrate a graphical representation of each flatrack load and container load.

During testing, tiedown procedures for palletization and containerization should be documented in detail. These documented tiedown procedures should be incorporated in the manual of the Bailey Bridge.

This study indicates that the overhead-bracing supports and components of the M2BB Conversion Set and Cable Reinforcement Set can be loaded on Configuration A and B (when the erection equipment is not required) or on Configurations C and F. If the overhead-bracing supports and components of the M2BB Conversion Set and Cable Reinforcement Set are required, there is no need for extra PLS flatracks or ISO containers.

Once the MRBC is issued the HDSB, the M2BB will be removed from the MRBC. Packaging M2BB components on M1/M1077 flatracks will facilitate this process. No additional reconfiguration, repalletizing, or repackaging is required. The M1/M1077 flatracks can be downloaded at storage sites with minimal additional preparation being required.

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7. APPENDIXES

- Appendix 1: M-2 Bailey Bridge Existing Truck Loads In Accordance With FM 5-277
- Appendix 2: Components of a M-2 Bailey Bridge Basic Set
- Appendix 3: Components of a M-2 Bailey Bridge Erection Equipment Set
- Appendix 4: M-2 Bailey Bridge Palletization PLS Flatrack Load Configurations
- Appendix 5: M-2 Bailey Bridge Containerization ISO Container Load Configurations
- Appendix 6: M-2 Bailey Bridge Palletization and Containerization Payload Distribution
- Appendix 7: Models of M-2 Bailey Bridge Palletization PLS Flatrack Load Configurations
- Appendix 8: Models of M-2 Bailey Bridge Containerization ISO Container Load Configurations

APPENDIX 1

M-2 BAILEY BRIDGE

EXISTING TRUCK LOADS IN ACCORDANCE WITH FM 5-277
(USING 5-TON DUMP TRUCKS & 4-TON BOLSTER TRAILERS)

LOAD	CARRIER	TYPE OF LOAD	MAIN COMPONENTS (WITH QUANTITY)	NET WEIGHT kg (lb)	NO. OF LOADS REQUIRED PLATOON	COMPANY
#1	Truck	Part & Grillage	Erection Equipment	4462 (9816)	1	2
#2	Truck	Launching Nose	9 Panels 8 Sway Braces Launching Nose Links	3552 (7373)	1	2:
#3	Truck	Panel	9 Panels 4 Ribands 4 Sway Braces Erection Tools	3308 (7277)	6	12
#4	Trailer	Transom	7 Transoms	1966 (4326)	4	8
#5	Truck	Deck	52 Chess 8 Button Stringers 16 Plain Stringers	4438 (9764)	2	4
#6	Truck	Ramp	32 Chess 4 Button Ramps 8 Plain Ramps 4 Ribands 2 15-ton jacks	3949 (8686)	2	4
#7	Trailer	Footwalk	16 Footwalks Rope for handrail	1375 (3024)	1	2
#8	Truck	Spares	Spares of Basic Set and Erection Equipment Set	2841 (6250)	1	1

APPENDIX 2

COMPONENTS OF A M-2 BAILEY BRIDGE BASIC SET

(SC 5420-97-E39, NSN 5420-00-530-3784)

NOMENCLATURE	: WEIGHT	: QTY	: AUT	: TOT WT	: NOTES
	: (lb)	:	:	: (lb)	:
Footwalk Bearer	: 23.00	: 80	:	: 1,840	:
Bracing Bolt	: 1.00	: 500	:	: 500	:
Chord Bolt	: 7.50	: 200	:	: 1,500	:
End-Post Bolt	: 0.75	: 24	:	: 18	:
Riband Bolt	: 4.50	: 300	:	: 1,350	:
Sway Brace	: 68.00	: 64	:	: 4,352	:
Chess	: 65.00	: 370	:	: 24,050	:
Transom Clamp	: 7.00	: 300	:	: 2,100	:
Aluminum Footwalk	:	: 36	:	:	:
Wood Footwalk	: 104.00	: 36	:	: 3,744	: Not included in
	:	:	:	:	: Supply Catalog
Bracing Frame	: 44.00	: 50	:	: 2,000	:
Hexagon Plain Nut	:	: 24	:	:	:
Panel (Truss)	: 577.00	: 126	:	: 72,702	:
Ramp Pedestal	: 93.00	: 16	:	: 1,488	:
Steel Picket	: 12.00	: 40	:	: 480	:
Panel Pin	: 6.10	: 300	:	: 1,830	:
Short Panel Pin	: 5.80	: 25	:	: 145	:
Sway-Brace Pin	: 1.10	: 50	:	: 55	:
Base Plate	: 381.00	: 8	:	: 3,048	:
Tie Plate	: 3.50	: 25	:	: 88	:
Female End Post	: 130.00	: 12	:	: 1,560	:
Male End Post	: 121.00	: 12	:	: 1,452	:
Footwalk Post	: 10.00	: 80	:	: 800	:
Raker	: 22.00	: 64	:	: 1,048	:
Button Ramp	: 348.00	: 16	:	: 5,568	:
Plain Ramp	: 338.00	: 32	:	: 10,816	:
Pin Retainer	: 0.13	: 1,000	:	: 130	:
Riband	: 162.00	: 48	:	: 7,776	:
Fibrous Rope	: 160.00	: 1	:	: 160	:
Hexagon Cap Screw	:	: 24	:	:	:
Bearing Shoe	: 68.00	: 16	:	: 1,088	:
Button Stringer	: 267.00	: 36	:	: 9,612	:
Plain Stringer	: 260.00	: 72	:	: 18,720	:
Transom	: 618.00	: 56	:	: 34,608	:
Parts & Tools Bag	:	: 20	:	:	:

APPENDIX 3

**COMPONENTS OF A M-2 BAILEY BRIDGE
ERECTION EQUIPMENT SET**

(SC 5420-97-E40, NSN 5400-00-530-3785)

NOMENCLATURE	: WEIGHT	: QTY	: AUT	: TOT WT	: NOTES
	: (lb)	:	:	: (lb)	:
Carrying Bar (42" long)	: 8.00	: 14	:	: 112	:
Double Block (3/4" rope)	: 8.00	: 8	:	: 64	:
Triple Block (1" rope)	: 20.00	: 4	:	: 80	:
Snatch Block (3/4" rope)	: 6.30	: 4	:	: 25	:
Pin Extractor (~40" long)	: 18.00	: 4	:	: 72	:
Double-Face Hand Hammer	: 8.00	: 12	:	: 96	:
Carpenter Hammer (Curved Claw	: 1.00	: 1	:	: 1	:
Socket Wrench Handle, Steel	:	: 10	:	:	:
Reversible	:	:	:	:	:
Holdfast w/ 9 pickets	: 160.00	: 12	:	: 1,920	:
Chord Jack	: 82.00	: 6	:	: 492	:
Rack Bar Jack, 15-ton	: 128.00	: 10	:	: 1,280	:
Panel Lever	: 48.00	: 6	:	: 288	:
Launching Nose Link	: 28.00	: 24	:	: 672	:
Softwood Lumber, Dimension	: 18.00	: 324	:	: 5,832	:
Softwood Lumber, Timber	: 52.00	: 194	:	: 10,088	:
Rubber Mallet	:	: 10	:	:	:
Steel Nail, 50lb/Box	: 50.00	: 6	:	: 300	:
Common Nail, Box	:	: 20	:	:	:
Plain Roller	: 116.00	: 12	:	: 1,392	:
Rocking Roller	: 206.00	: 12	:	: 2,472	:
Guide Roller Assembly	:	: 6	:	:	:
Transom Roller	: 12.00	: 4	:	: 48	:
Rope, 3" Circular	: 325.00	: 1	:	: 325	:
Rope, 2 1/4" Circular	: 100.00	: 1	:	: 100	:
Rope, 2" Circular	: 160.00	: 3	:	: 480	:
Shackle, Anchor-Type	: 5.00	: 4	:	: 20	:
Jack Shoe	: 36.00	: 8	:	: 288	:
Sling & Wire Rope Assembly	:	: 4	:	:	:
Socket, 1 1/8", 12 PT	:	: 10	:	:	:
Socket, 1 7/8", 12 PT	:	: 10	:	:	:
Steel Anchor Stake	: 12.00	: 18	:	: 216	:
Rocking Roller Template	: 78.00	: 12	:	: 936	:
Plain Roller Template	: 22.00	: 12	:	: 264	:
Carrying Tong	: 13.00	: 20	:	: 260	:
Wood Wedge	: 12.00	: 32	:	: 384	:
Wire Rope Assembly	: 12.00	: 4	:	: 48	:
Box Wrench, 3/4", 12 PT	:	: 4	:	:	:
Open End Wrench, 1 1/8"	:	: 10	:	:	:
Open End Wrench, 1 1/2"	:	: 10	:	:	:
Open End Wrench, 1 7/8"	:	: 10	:	:	:
Single Socket Wrench, 1 1/8"	:	: 20	:	:	:

APPENDIX 4

M-2 BAILEY BRIDGE PALLETIZATION
PLS FLATRACK LOAD CONFIGURATIONS

(USING M1 FLATRACKS FOR CONFIGURATIONS A, B, C, E, F, G, AND M1077 FLATRACKS FOR CONFIGURATION D)

LOAD CONF	TYPE & NUMBER OF COMPONENTS	NET WEIGHT kg (lb)	HEIGHT ^a m (in)	EST CGZ ^a m (in)	NO. OF LOADS REQUIRED 80' DS : 130' DD
A	32 Rakers 162 Soft Lumber, Dimension ^b Erection Equipment Boxes ^{b,c}	6816 (15026)	1.58 (62.3)	0.62 (24.5)	1 : 2
B	9 Panels 97 Soft Lumber, Timber ^b Miscellaneous Boxes ^d	6863 (15131)	1.84 (72.3)	1.02 (40.3)	1 : 2
C	9 Panels 12 Plain Stringers 8 Sway Braces	4018 (8857)	1.84 (72.3)	1.04 (40.8)	3 : 6
D	28 Transoms	7850 (17304)	0.77 (30.5)	0.51 (20.2)	1 : 2
E	9 Panels 8 Button Ramps 4 Base Plates 6F & 6M End Posts 40 Footwalk (FW) Bearers 40 FW Posts	6675 (14715)	1.84 (72.3)	1.04 (41.0)	1 : 2
F	9 Panels 12 Ribands	4464 (9841)	1.84 (72.3)	1.03 (40.5)	2 : 4
G	185 Chess 18 Footwalks	6304 (13897)	2.06 (81.3)	1.74 (68.5)	1 : 2

^aFrom the base of the flatrack

^bErection Equipment, only loaded if required

^cErection Equipment Boxes include 7 Carrying Bars, 4 Double Blocks, 2 Triple Blocks, 2 Snatch Blocks, 2 Pin Extractors, 6 Double-Face Hammers, 1 Carpenter Hammer, 5 Socket Wrench Handles, 6 Holdfast w/ 9 pickets, 3 Chord Jacks, 5 15-ton Rack Bar Jacks, 3 Panel Levers, 12 Launching Nose Links, 5 Rubber Mallets, 3 Steel Nail, 50lb/Box, 10 Common-Nail Box, 6 Plain Rollers, 6 Rocking Rollers, 3 Guide Roller Assemblies, 2 Transom Rollers, 1 3" Circular Rope, 1 2 1/4" Circular Rope, 2 2" Circular Ropes, 2 Anchor-Type Shackles, 4 Jack Shoes, 2 Sling & Wire Rope Assemblies, 5 1 1/8", 12 PT Sockets, 5 1 7/8", 12 PT Sockets, 9 Steel Anchor Stakes, 6 Rocking Roller Templates, 6 Plain Roller Templates, 10 Carrying Tongues, 16 Wood Wedges, 2 Wire Rope Assemblies, 2 3/4", 12 PT Box Wrenches, 5 1 1/8" Open End Wrenches, 5 1 1/2" Open End Wrenches, 5 1 7/8" Open End Wrenches, 10 1 1/8" Single Socket Wrenches.

^dMiscellaneous Boxes include 250 Bracing Bolts, 100 Chords Bolts, 150 Riband Bolts, 150 Transom Clamps, 20 Steel Pickets, 150 Panel Pins, 15 Short Panel Pins, 25 Sway Braces Pins, 13 Tie Plates, 500 Pin Retainers, 1 Roll of Ropes, and 10 Tools and Parts Bags, 12 Hex Nuts with Caps, and 12 End Post Bolts.

APPENDIX 5

M-2 BAILEY BRIDGE CONTAINERIZATION
ISO CONTAINER LOAD CONFIGURATIONS

(USING 20-FOOT CONTAINERS FOR CONFIGURATIONS A, B, C, E, F, G, AND 40-FOOT CONTAINERS FOR CONFIGURATION D)

LOAD CONF	TYPE & NUMBER OF COMPONENTS	NET WEIGHT kg (lb)	HEIGHT ^a m (in)	EST CGZ ^a m (in)	NO. OF LOADS REQUIRED 80' DS : 130' DD
A	32 Rakers 18 Button Stringers 162 Soft Lumber, Dimension ^b Erection Equipment Boxes ^{b,c}	6816 (15026)	1.30 (51.0)	0.34 (13.3)	1 : 2
B	9 Panels 8 Sway Braces 97 Soft Lumber, Timber ^b Miscellaneous Boxes ^d	6863 (15131)	1.55 (61.0)	0.74 (29.0)	1 : 2
C	9 Panels 12 Plain Stringers 8 Sway Braces	4018 (8857)	1.55 (61.0)	0.75 (29.0)	3 : 6
D	28 Transoms 9 Panels 8 Button Ramps 8 Ramp Pedestals 4 Base Plates 6F & 6M End Posts 40 Footwalk (FW) Bearers 40 FW Posts 8 Shoe Bearings	7850 (17304)	0.52 (20.5)	0.26 (10.3)	1 : 2
E	9 Panels 8 Button Ramps 8 Ramp Pedestals 4 Base Plates 6F & 6M End Posts 40 Footwalk (FW) Bearers 40 FW Posts 8 Shoe Bearings	6675 (14715)	1.55 (61.0)	0.76 (29.8)	1 : 2
F	9 Panels 8 Plain Ramps 12 Ribands	4464 (9841)	1.55 (61.0)	0.74 (29.3)	2 : 4
G	185 Chess 18 Footwalks	6304 (13897)	1.78 (70.0)	1.45 (57.2)	1 : 2

^aFrom the container deck

^bErection Equipment, only loaded if required

^cErection Equipment Boxes include 7 Carrying Bars, 4 Double Blocks, 2 Triple Blocks, 2 Snatch Blocks, 2 Pin Extractors, 6 Double-Face Hammers, 1 Carpenter Hammer, 5 Socket Wrench Handles, 6 Holdfast w/ 9 pickets, 3 Chord Jacks, 5 15-ton Rack Bar Jacks, 3 Panel Levers, 12 Launching Nose Links, 5 Rubber Mallets, 3 Steel Nail, 50lb/Box, 10 Common-Nail Box, 6 Plain Rollers, 6 Rocking Rollers, 3 Guide Roller Assemblies, 2 Transom Rollers, 1 3" Circular Rope, 1 2 1/4" Circular Rope, 2 2" Circular Ropes, 2 Anchor-Type Shackles, 4 Jack Shoes, 2 Sling & Wire Rope Assemblies, 5 1 1/8", 12 Pt Sockets, 5 1 7/8", 12 Pt Sockets, 9 Steel Anchor Stakes, 6 Rocking Roller Templates, 6 Plain Roller Templates, 10 Carrying Tongues, 16 Wood Wedges, 2 Wire Rope Assemblies, 2 3/4", 12 Pt Box Wrenches, 5 1 1/8" Open End Wrenches, 5 1 1/2" Open End Wrenches, 5 1 7/8" Open End Wrenches, 10 1 1/8" Single Socket Wrenches.

^dMiscellaneous Boxes include 250 Bracing Bolts, 100 Chords Bolts, 150 Riband Bolts, 150 Transom Clamps, 20 Steel Pickets, 150 Panel Pins, 15 Short Panel Pins, 25 Sway Braces Pins, 13 Tie Plates, 500 Pin Retainers, 1 Roll of Ropes, and 10 Tools and Parts Bags, 12 Hex Nuts with Caps, and 12 End Post Bolts.

APPENDIX 6

**M-2 BAILEY BRIDGE PALLETIZATION AND CONTAINERIZATION
PAYLOAD DISTRIBUTION**

Load :	Components			Net
Conf :	-----			Weight
:	Description	Size (in)	Weight (kg)	(kg)
A :	Erection Equipment Load	:	:	6,816
:	18 Button Stringers	: 86 x 21 x 120	: 2,180	:
:	162 Soft Lumber, Dimension	: 90 x 33 x 54	: 1,323	:
:	3 Erection Equipment Boxes	: 32 x 18 x 60	: 2,994	:
:	32 Rakers	: 40 x 26 x 44	: 319	:
B :	Launching Load	:	:	6,863
:	9 Panels	: 61 x 59 x 120	: 2,355	:
:	8 Sway Braces	: 18 x 7 x 105	: 247	:
:	97 Soft Lumber, Timber	: 90 x 42 x 54	: 2,288	:
:	4 Miscellaneous Boxes	: 23 x 20 x 50	: 1,973	:
C :	Panel Load	:	:	4,018
:	9 Panels	: 61 x 59 x 120	: 2,355	:
:	12 Plain Stringers	: 48 x 21 x 120	: 1,416	:
:	8 Sway Braces	: 18 x 7 x 105	: 247	:
D :	Transom Load	:	:	7,850
:	28 Transoms	: 63 x 21 x 239	: 7,850	:
E :	Ramp/Others Load #1	:	:	6,675
:	9 Panels	: 61 x 59 x 120	: 2,355	:
:	8 Button Ramps	: 45 x 21 x 120	: 1,263	:
:	8 Ramp Pedestals	: 27 x 21 x 80	: 337	:
:	25 Bracing Frames	: 38 x 20 x 50	: 499	:
:	4 Base Plates	: 36 x 24 x 56	: 692	:
:	6 F & 6 M End Posts	: 28 x 20 x 74	: 683	:
:	40 Footwalk Bearers	: See Note (1)	: 417	:
:	40 Footwalk Posts	: 30 x 13 x 56	: 182	:
:	8 Shoe Bearings	: 35 x 8 x 60	: 247	:
F :	Ramp/Others Load #2	:	:	4,464
:	9 Panels	: 61 x 59 x 120	: 2,355	:
:	8 Plain Ramps	: 40 x 21 x 120	: 1,227	:
:	12 Ribands	: 20 x 30 x 120	: 882	:
G :	Chess Load	:	:	6,304
:	185 Chess	: See Note (2)	: 5,455	:
:	18 Footwalks	: See Note (3)	: 849	:

- Notes:**
- (1) There are 5 bundles of 8 footwalk bearers, the dimension of each bundle is 9 x 12 x 46 in.
 - (2) There are 11 bundles of 16 chess and 9 single chess. The dimension of the chess bundle is 35 x 10 x 166 in.
 - (3) There are 3 bundles of 6 footwalks, the dimension of each footwalk bundle is 3 x 30 x 120 in.

APPENDIX 7

**MODELS OF M-2 BAILEY BRIDGE PALLETIZATION
PLS FLATRACK LOAD CONFIGURATIONS**

- Figure 1: Flatrack Load Configuration A (M1)
- Figure 2: Flatrack Load Configuration B (M1)
- Figure 3: Flatrack Load Configuration C (M1)
- Figure 4: Flatrack Load Configuration D (M1077)
- Figure 5: Flatrack Load Configuration E (M1)
- Figure 6: Flatrack Load Configuration F (M1)
- Figure 7: Flatrack Load Configuration G (M1)

FIGURE 1: FLATRACK LOAD CONFIGURATION A (M1)
(18 Button Stringers, 32 Rakers, 162 Soft Lumber - Dimension,
and Erection Equipment Boxes)

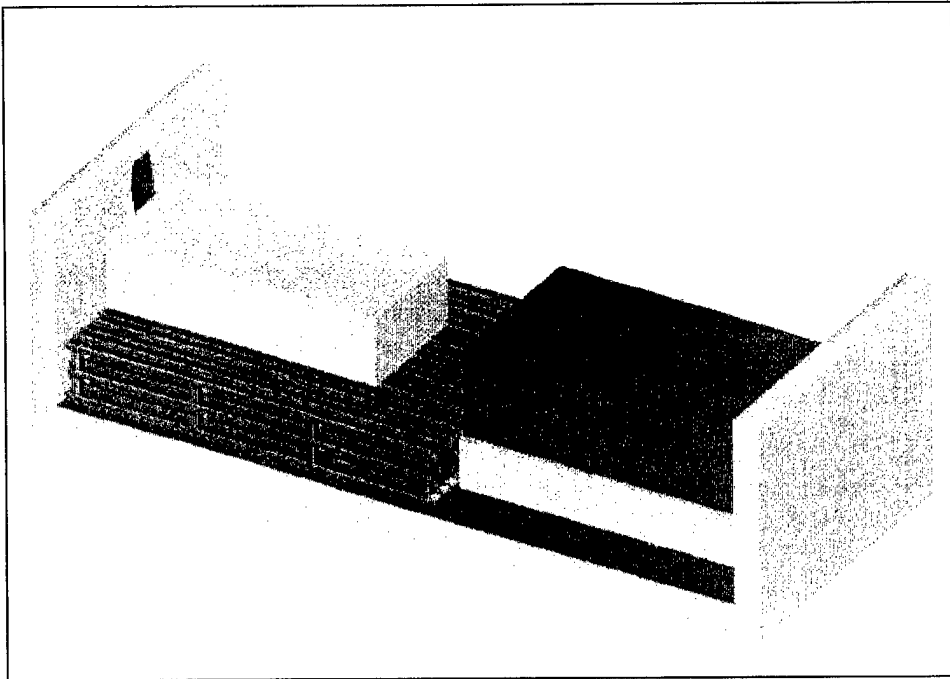


FIGURE 2: FLATRACK LOAD CONFIGURATION B (M1)
(9 Panels, 8 Sway Braces, 97 Soft Lumber - Timber,
and Miscellaneous Boxes)

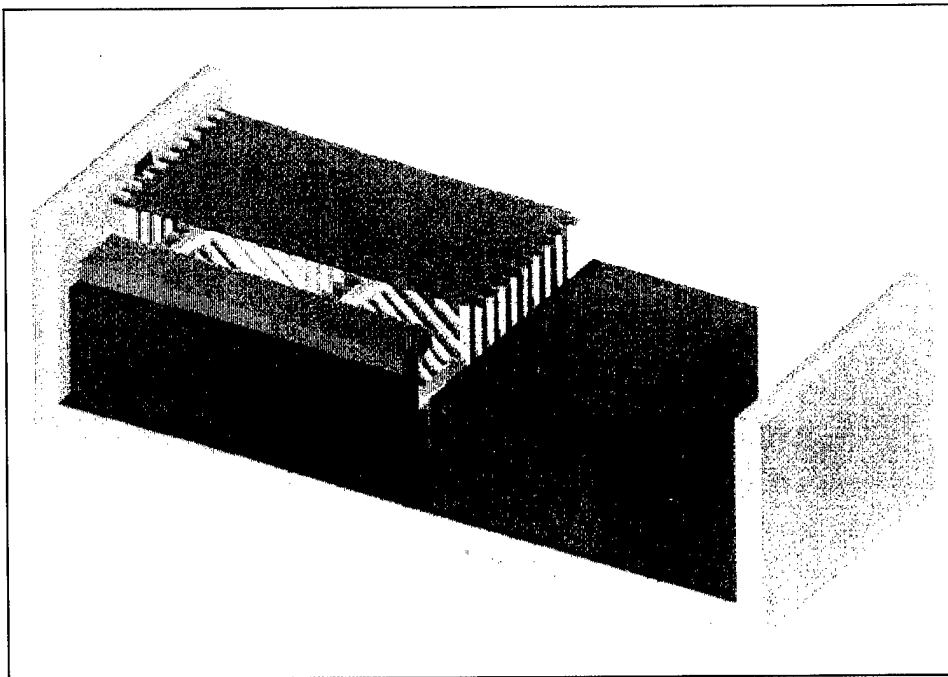


FIGURE 3: FLATRACK LOAD CONFIGURATION C (M1)
(9 Panels, 12 Plain Stringers, and 8 Sway Braces)

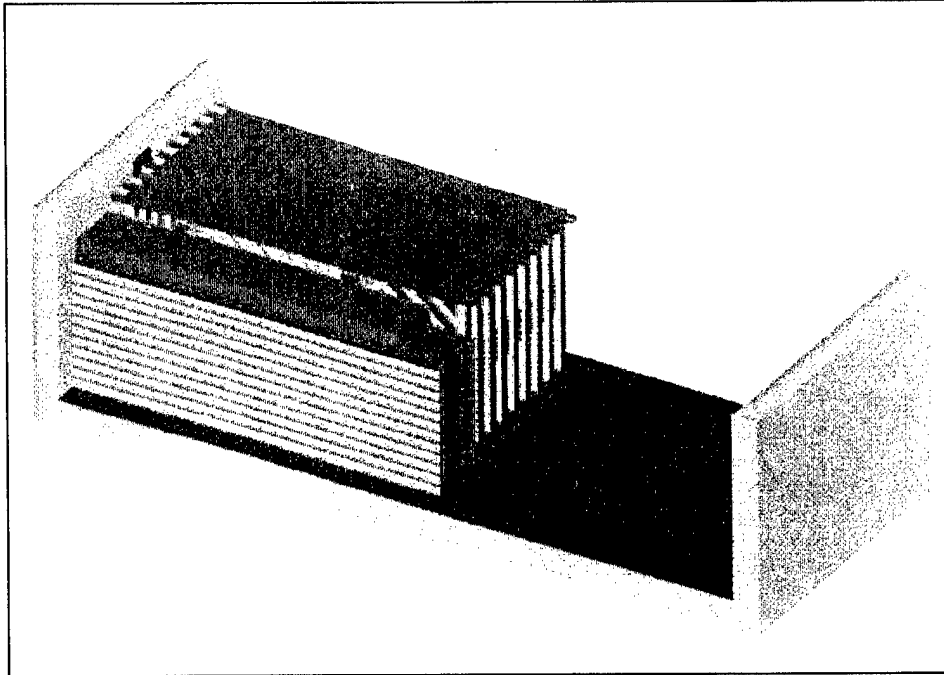


FIGURE 4: FLATRACK LOAD CONFIGURATION D (M1077)
(28 Transoms)

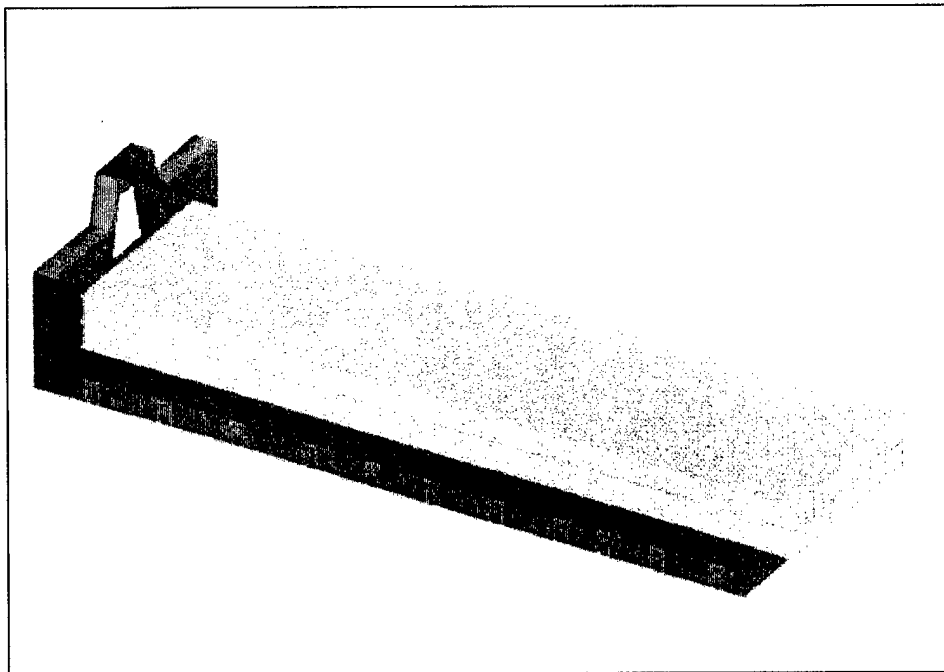


FIGURE 5: FLATRACK LOAD CONFIGURATION E (M1)
(9 Panels, 25 Bracing Frames, 8 Button Ramps, 8 Ramp Pedestals, 4 Base Plates, 6 Female and 6 Male End Posts, 40 Footwalk Bearers, 40 Footwalk Posts, and 8 Shoe Bearings)

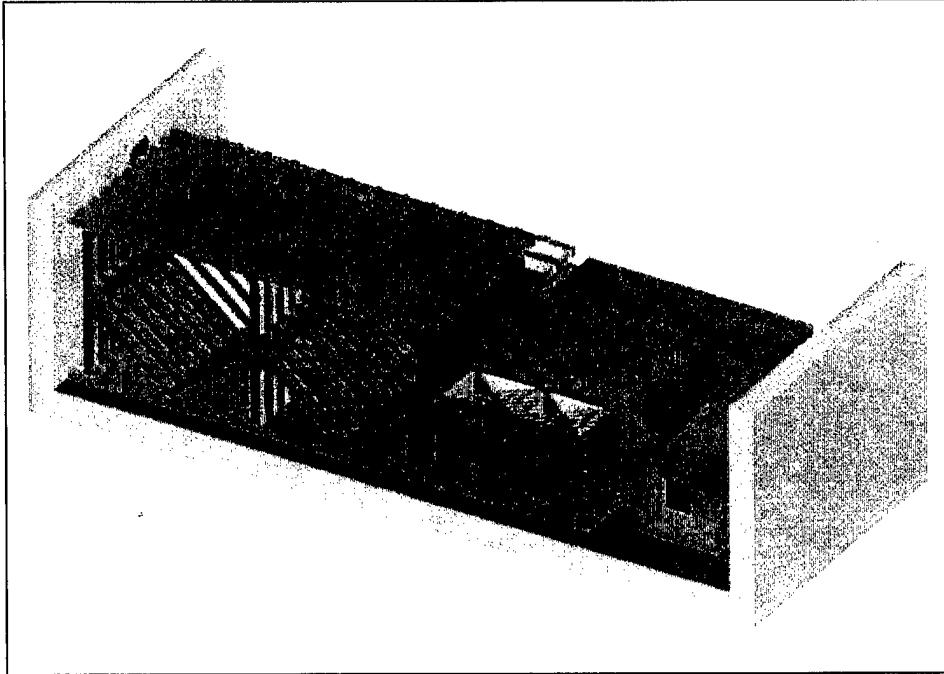


FIGURE 6: FLATRACK LOAD CONFIGURATION F (M1)
(9 Panels, 8 Plain Ramps, and 12 Ribands)

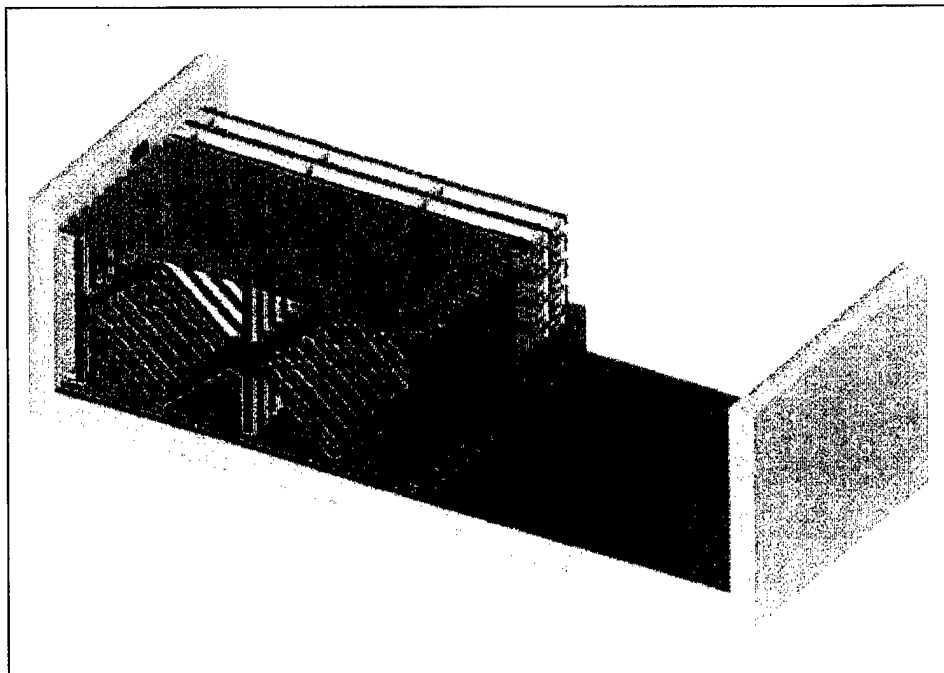
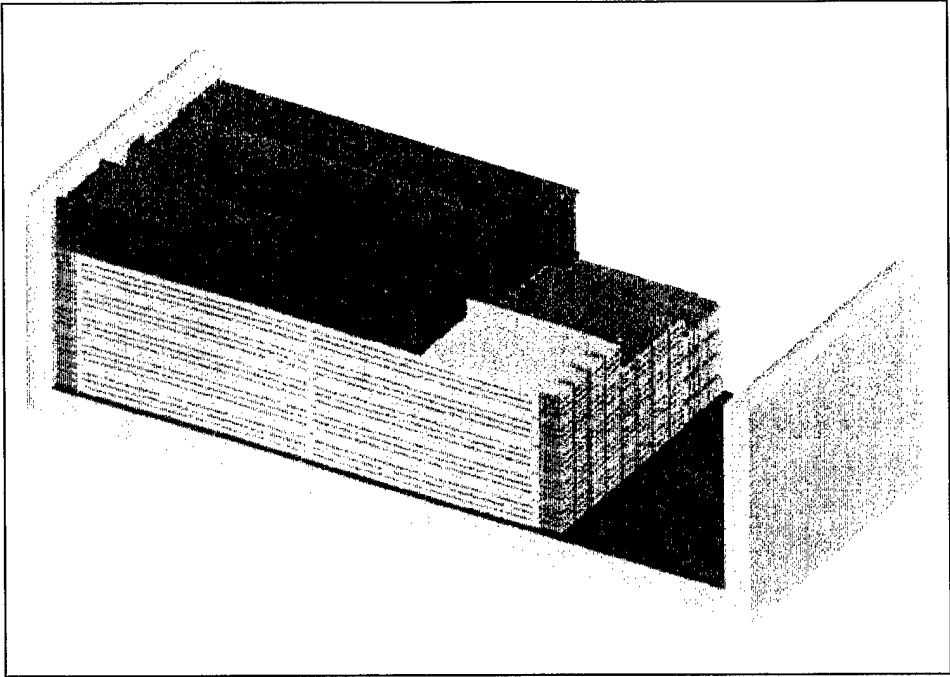


FIGURE 7: FLATRACK LOAD CONFIGURATION G (M1)
(185 Chess and 18 Footwalks)



APPENDIX 8

**MODELS OF M-2 BAILEY BRIDGE CONTAINERIZATION
ISO CONTAINER LOAD CONFIGURATIONS**

- Figure 1: Container Load Configuration A (20-FOOT)
- Figure 2: Container Load Configuration B (20-FOOT)
- Figure 3: Container Load Configuration C (20-FOOT)
- Figure 4: Container Load Configuration D (40-FOOT)
- Figure 5: Container Load Configuration E (20-FOOT)
- Figure 6: Container Load Configuration F (20-FOOT)
- Figure 7: Container Load Configuration G (20-FOOT)

FIGURE 1: CONTAINER LOAD CONFIGURATION A (20-FOOT)
(18 Button Stringers, 32 Rakers, 162 Soft Lumber - Dimension,
and Erection Equipment Boxes)

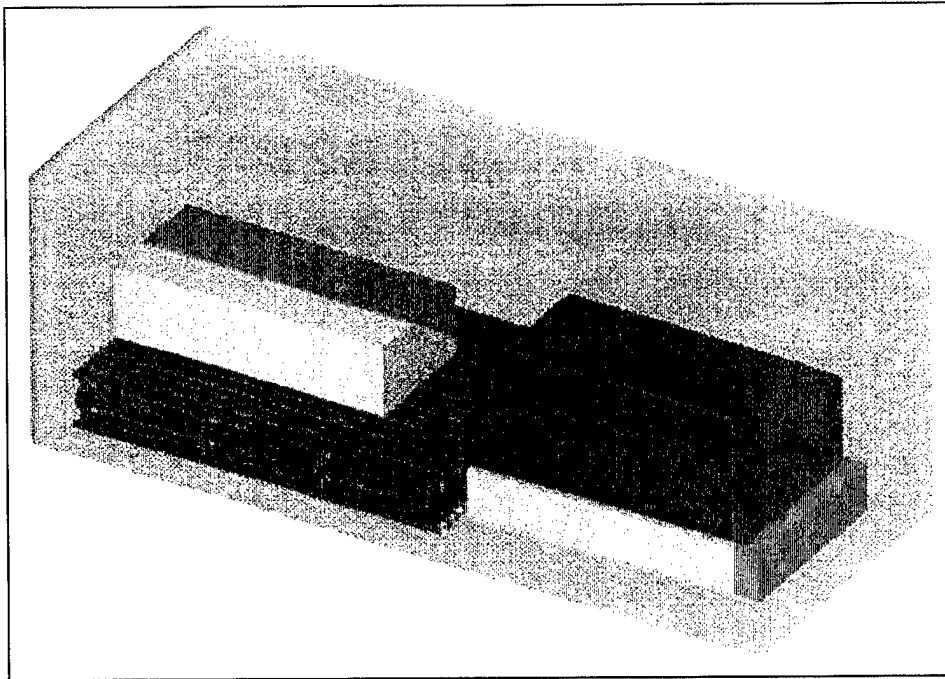


FIGURE 2: CONTAINER LOAD CONFIGURATION B (20-FOOT)
(9 Panels, 8 Sway Braces, 97 Soft Lumber - Timber,
and Miscellaneous Boxes)

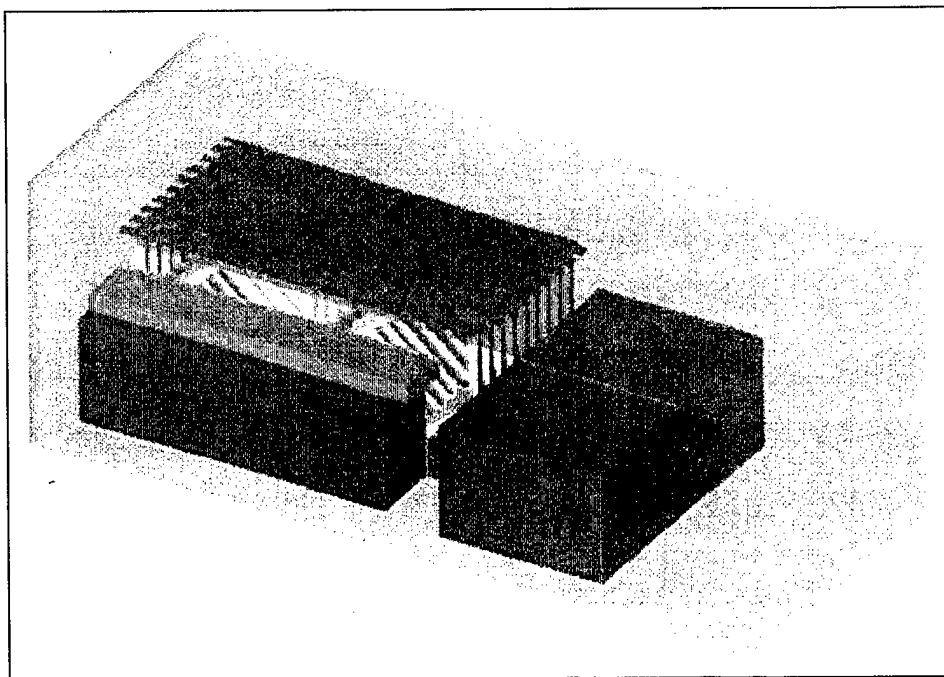


FIGURE 3: CONTAINER LOAD CONFIGURATION C (20-FOOT)
(9 Panels, 12 Plain Stringers, and 8 Sway Braces)

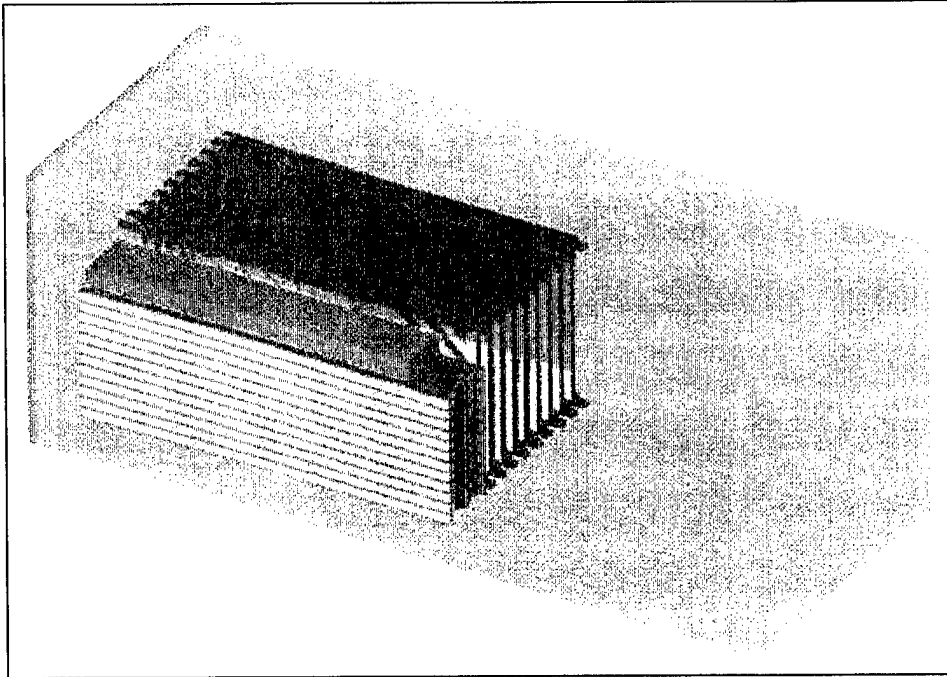


FIGURE 4: CONTAINER LOAD CONFIGURATION D (40-FOOT)
(28 Transoms)

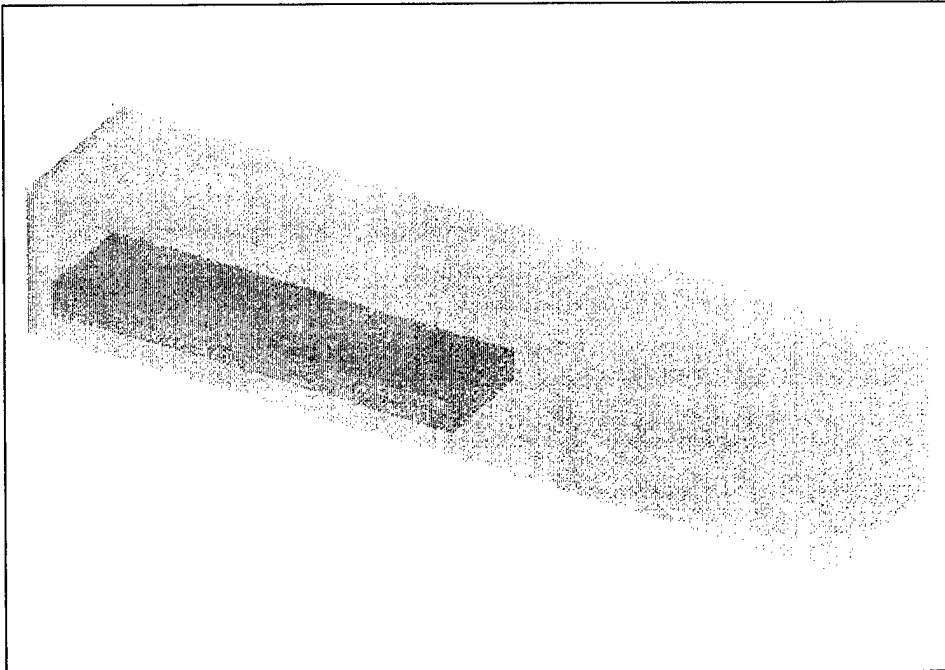


FIGURE 5: CONTAINER LOAD CONFIGURATION E (20-FOOT)
(9 Panels, 25 Bracing Frames, 8 Button Ramps, 8 Ramp Pedestals, 4 Base Plates, 6 Female and 6 Male End Posts, 40 Footwalk Bearers, 40 Footwalk Posts, and 8 Shoe Bearings)

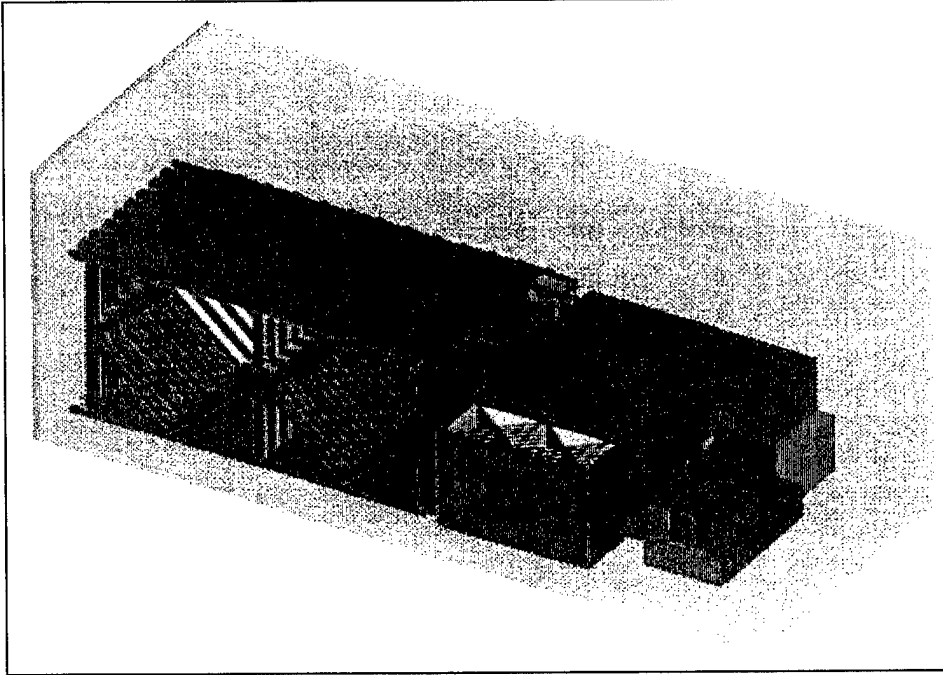


FIGURE 6: CONTAINER LOAD CONFIGURATION F (20-FOOT)
(9 Panels, 8 Plain Ramps, and 12 Ribands)

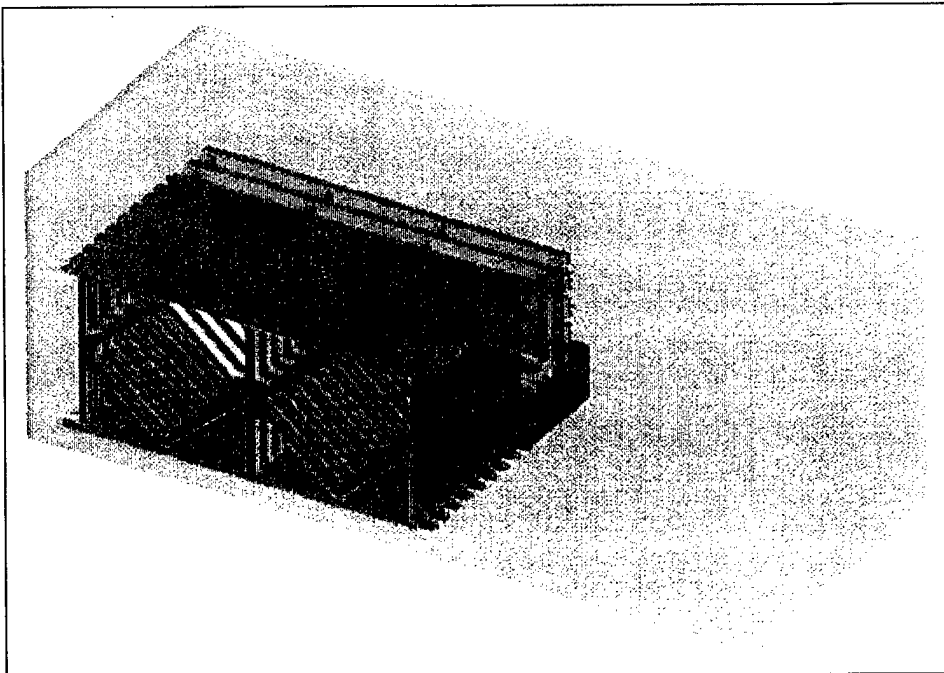


FIGURE 7: CONTAINER LOAD CONFIGURATION G (20-FOOT)
(185 Chess and 18 Footwalks)

