AD NUMBER: AD0105722
LIMITATION CHANGES
TO: Approved for public release; distribution is unlimited.
FROM: Distribution authorized to U.S. Government agencies and their contractors; Administrative or operational use; 31 May 1956. Other requests shall be referred to U.S. Naval Civil Engineering and Research and Evaluation Laboratory, Port Hueneme, CA 93035.
AUTHORITY
ST-A USNCBC LTR, 24 OCT 1974

Project NY 113 001-9
Technical Memorandum M-110

SIDE LAUNCHING OF PONTOON STRUCTURES

31 May 1956

u. s.
naval
civil
engineering
research
and
evaluation
laboratory

port hueneme,
california

U.S. Naval Civil Engineering Research and Evaluation Laboratory
Port Hueneme, California

Project NY 113 001-9
Technical Memorandum M-110

SIDE LAUNCHING OF PONTOON STRUCTURES

31 May 1956

J.E. Schroeder
R.C. Towne

SUMMARY

The Bureau of Yards and Docks initiated Project NY 113 001-9 to determine the feasibility of launching pontoon structures from LST's, with a view to reducing damage and extending the life of the structures.

This memorandum covers the results of tests of 89 launchings conducted with a 3 x 4 barge, a 3 x 12 barge with and without propulsion unit, a 2 x 4 barge and a 2 x 30 causeway from ship rail heights up to 13 feet. These tests proved that the damage could be reduced to acceptable limits or eliminated. Winching the barges into the water from the vertical position was found to be the most satisfactory method for reducing this damage.

CONTENTS

TABLE

ILLUSTRATIONS

INTRODUCTION

Design criteria for new LST's propose a greater freeboard than present LST's, resulting in a higher location of the launching shelf angle and correspondingly higher launching heights for pontoon structures. Under all operating conditions, the launching rail heights of the various classes of LST's vary from 3 ft 1 in. to 12 ft 2 in.

Early test launchings were made with a 3 x 12 barge (T6B and T7A pontoons),[1] a 2 x 30 causeway (T6B and T7A pontoons),[2] and a 3 x 12 ramp barge (P-1 and P-2 pontoons).[3] The damage sustained by the pontoon structures indicated that the launching impact would have to be reduced to protect the propulsion units and to prolong the life of the pontoons.

The purpose of this program was to determine the feasibility of launching pontoon structures from various heights, to determine the extent of the damage incurred by the pontoons when launched from various heights, and to provide information for reducing damage caused by launchings. This report covers the results of 89 launchings made with a 3 x 4 barge, a 3 x 12 ramp barge without propulsion unit, a 3 x 12 ramp barge with propulsion unit, a 2 x 4 barge, and a 2 x 30 causeway. Table I lists the launching schedule.

TEST PROCEDURE

A launching platform, fabricated from pontoons and I-beams, was erected on the dock adjacent to the water to simulate the side conditions of an LST. The launchings were conducted in a harbor in calm water; therefore the effect of ocean swells could not be determined. Provisions were made for adjusting the height of the launching rail at 1-ft intervals from 0 ft to 13 ft above the water (see Figure 1). Proper rail location with respect to the tide and the desired launching height permitted as many as ten launchings per day.

Accelerometers were mounted on the outboard single angle to measure the deceleration of the structure at the time of impact with the water. The accelerometers were positioned to measure deceleration perpendicular to the deck of the pontoon structures; all decelerations are in the direction and position just described.

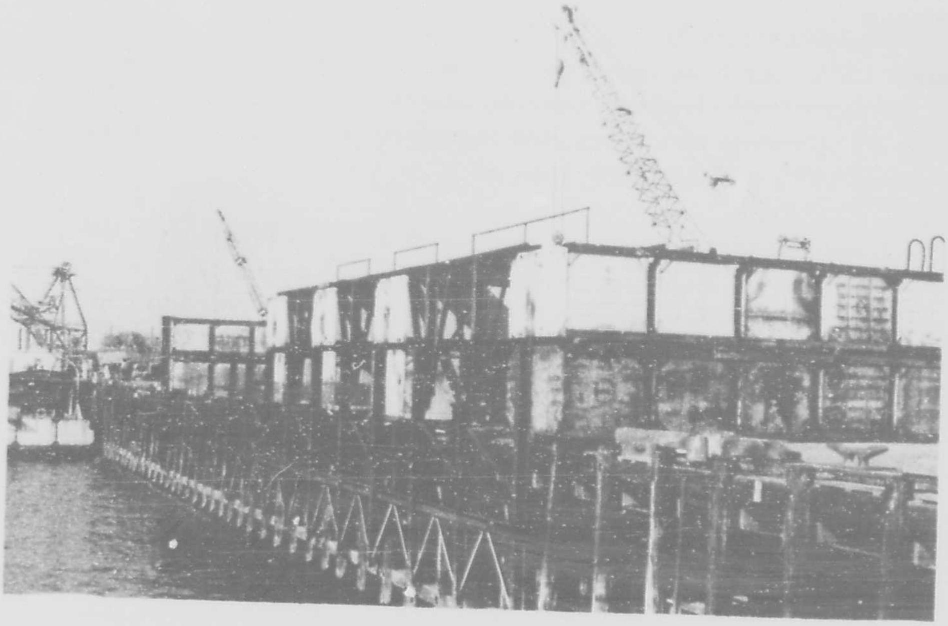

Figure 1. Launching platform with adjustable rail.

The accelerometers were of two types: a strain-gage type, manufactured by Stratham Laboratories, Los Angeles, California, with a range of ±100 g's, natural frequency of 600 cps, and damping by silicone oil at 0. 6 to 0.8 of critical; and a reluctance-gage type manufactured by North American Instruments, Inc., Altadena, California, with a range of ±100 g's and air-damped. This instrument has a response of ± 1 per cent in the range of 0 to 100 cps. Figure 2 is a typical trace of the deceleration of a pontoon structure entering the water.

Damage to the pontoons resulting from the launchings was manifested as indentation of the bottom plates and ultimate failure of the bottom interior framing and corner seam welds. A 3 x 4 barge was launched from the 3-ft launching rail height until excessive damage (failure of interior framing and corner seam welds) was incurred by the outboard string. The outboard string was replaced and launchings were made from the 11-ft launching rail height until excessive damage to the outboard string was again incurred. These launchings established a relationship between the deceleration readings, attitude of barge entry into the water, and the observed damage. Therefore subsequent

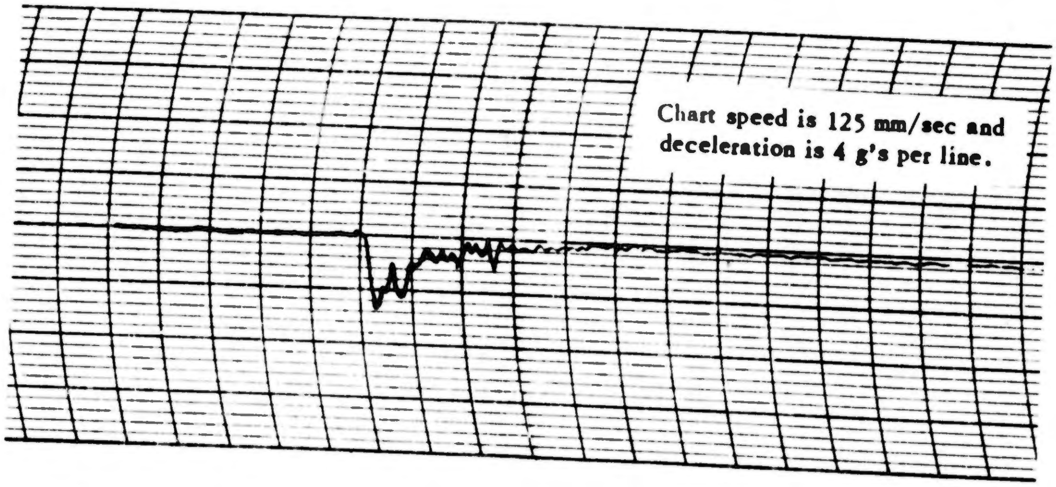

Figure 2. Typical trace of a barge deceleration. (The launching starts at the left and the first peak, -28 g's, is taken as the initial impact reading).

launchings were limited to the minimum number required to assure reliable deceleration measurements. It was found that the pontoon damage does not vary directly as the deceleration readings. For example, the amount of indentation of the pontoon bottom plates does not necessarily double when the deceleration reading increases from 40 to 80 g's.

TESTS

3 x 4 Test Barge. For the majority of launchings, a 3 x 4 barge was assembled, using P-5 plates top and bottom (links and pins, jewelry, and tie rods omitted). The pontoons in the outboard string were replaced as necessary to insure an accurate damage survey for correlation with impact deceleration readings. The use of the 3 x 4 barge expedited the handling and setting of the barge into the rail and reduced the number of pontoons excessively damaged in the program. Subsequent launching data revealed a close correlation between the 3 x 4 barge and the 3 x 12 ramp barge in both impact deceleration and pontoon damage. The decelerations recorded in launching a 3 x 4 barge from rail heights of 0 ft to 13 ft are given in Figure 3.

Six launchings, using different 3 x 4 barges, from rail heights of 3 ft and 11 ft resulted in excessive damage to the outboard string of pontoons. Indentation of the bottom plates reached a maximum of

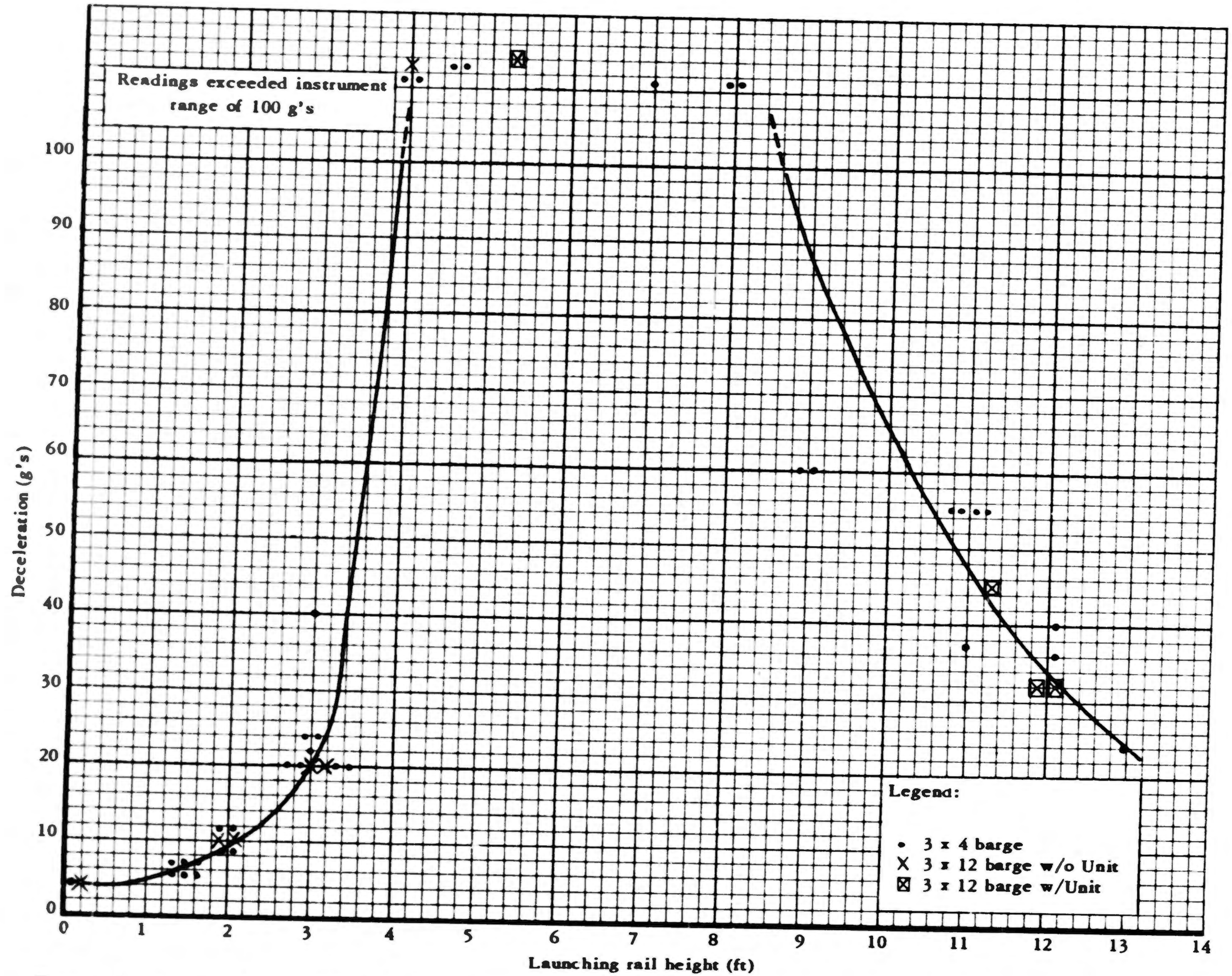

Figure 3. Launching rail height vs impact deceleration for 3 x 4 barge launched from conventional vertical position. (Accelerometer mounted over outboard single angle.)

3 inches, interior bottom framing failed, the corner seam welds failed, and the side plates buckled (see Figures 4 and 5). Decelerations measured from the 3-ft launching height were 20 to 24 g's at the outboard single angle. Decelerations measured from the 11-ft and 12-ft 2-in. launching rail heights were 55 to 60 g's and 36 to 40 g's, respectively, at the outboard single angle. The larger impact deceleration measured from the 11-ft and 12-ft rail heights resulted in damage similar to the damage from the 3-ft rail height. This similarity of damage for widely divergent decelerations is attributed to the attitude of barge entry into the water. From the 11-ft and 12-ft heights entry is on the corner of the structure, whereas from the 3-ft height entry is almost horizontal.

Six launchings from a rail height of 1 ft 6 in. resulted in only small indentations in the bottom plates, with no failure of the bottom interior framing or corner seam welds. Decelerations measured at the outboard single angle for this height varied from 12 g's to 15 g's. The large reduction in measured deceleration achieved by a reduction in rail height from 3 ft to 1 ft 6 in. is attributed to the barge's rolling into the water and thus being materially slowed down before the outboard string strikes the water.

Decelerations measured for other launching rail heights with the barge in the conventional vertical position are given in Table I and Figure 3. Analysis of Figure 3 reveals that impact decelerations rise steadily from rail heights of 0 to approximately 5 feet, exceed 100 g's between 5-ft and 8-ft rail heights, and then steadily reduce through 13 feet as the barge enters more nearly on the corner rather than striking flat.

In addition to the launchings from the conventional vertical position, several launchings were made with the barge lowered prior to release through an angle of 73 degrees (outboard deck angle 6 ft 5 in. above horizontal) to 90 degrees from the vertical (see Figure 6). The barge was launched in the lowered position from rail heights of 7 ft, 11 ft, and 12 ft. Resulting decelerations for these launchings are given in Table I. Effect of degrees from true horizontal for the 11 ft rail height above is shown in Figure 7. The barge did not strike the simulated LST side while falling or rebound into it after entering the water.

Material reductions in damage from launching heights of 11 ft and 12 ft were achieved by lowering the barge through an angle from the vertical prior to the free fall. Decelerations were reduced from

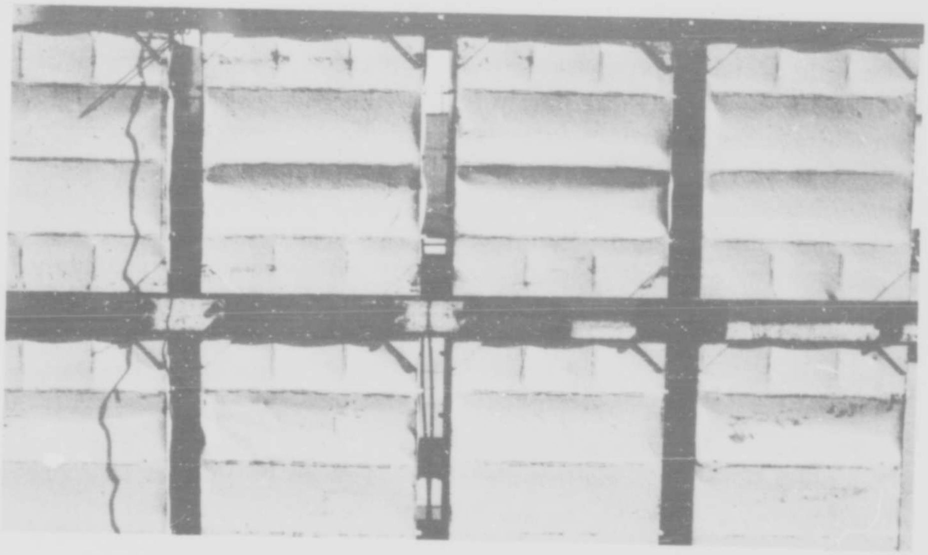

Figure 4. Indentation of bottom plates of 3 x 4 barge after launching.

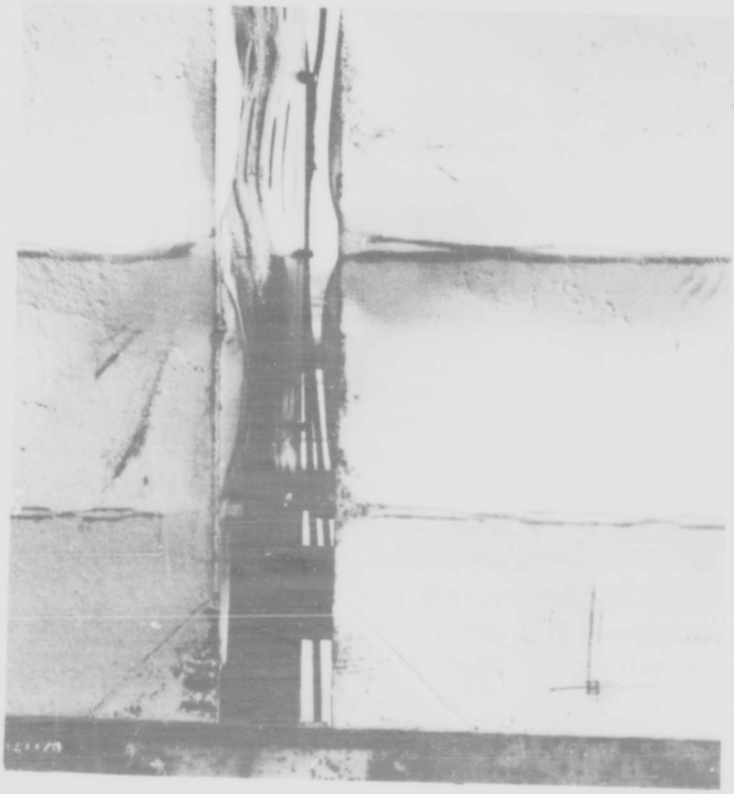

Figure 5. Side buckling of pontoons on 3 x 4 barge after launchings.

TABLE I. Schedule of launchings.

Launching rail height	Barge position (deg from vertical)	Height of barge outboard edge above horizontal	Number of launchings according to barge sizes (Average decelerations at outboard single angle, measured in g's, are given in parentheses).				
			3 x 4	3 x 12 w/o unit	3 x 12 w/unit	2 x 4	2 x 30
0' 0''	0°	...	1 (4)	1 (4)			
1' 6''	0°	...	7 (6)				
2' 0''	0°	...	4 (10)	1 (10)			
3' 0''	0°	...	9 (20)	3 (20)			
4' 0''	0°	...	2 (100)	1 (100)			
4' 6''	0°	...	2 (100)				
5' 4''	0°	...			2 (100)		
7' 0''	0°	...	1 (100)			1 (100)	
7' 0''	86°	8''	4 (9)				
8' 0''	0°	...	2 (100)			1 (44)	
9' 0''	0°	...	2 (50)				
11' 0''	0°	...	6 (55)		1 (45)	3 (20)	1 (18)
11' 0''	73°	77''	2 (22)				
11' 0''	80°	48''	2 (16)				
11' 0''	83°	30''	2 (18)				
11' 0''	84°	24''			1 (16)		
11' 0''	86°	18''	2 (18)				
11' 0''	87°	12''				1 (8)	
11' 0''	88°	8''	6 (8)		1 (8)		
11' 0''	90°	0''	1 (4)			1 (4)	
11' 0''	lowered into water	lowered into water	1 (16)				
11' 4''	89°	6''	1 (8)				
12' 0''	0°		2 (34)			1 (16)	
12' 0''	lowered to 90° and free wheeled	lowered to 90° and free wheeled	1 (8)				
12' 0''	lowered into water	lowered into water	4 (8)				
12' 2''	0°		2 (38)		2 (30)		
13' 0''	0°				1 (24)		

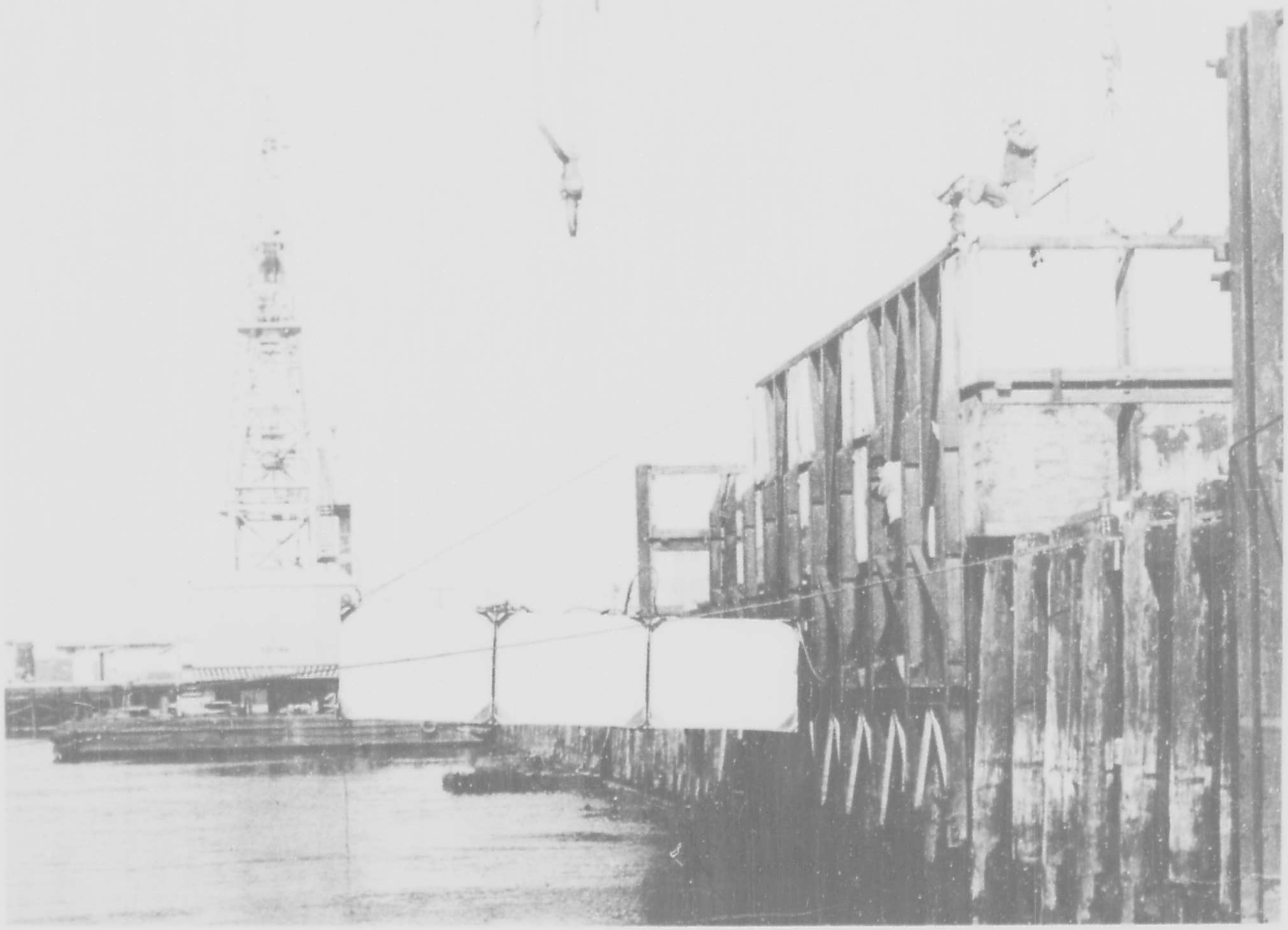

Figure 6. 3 x 4 barge in lowered position prior to release.

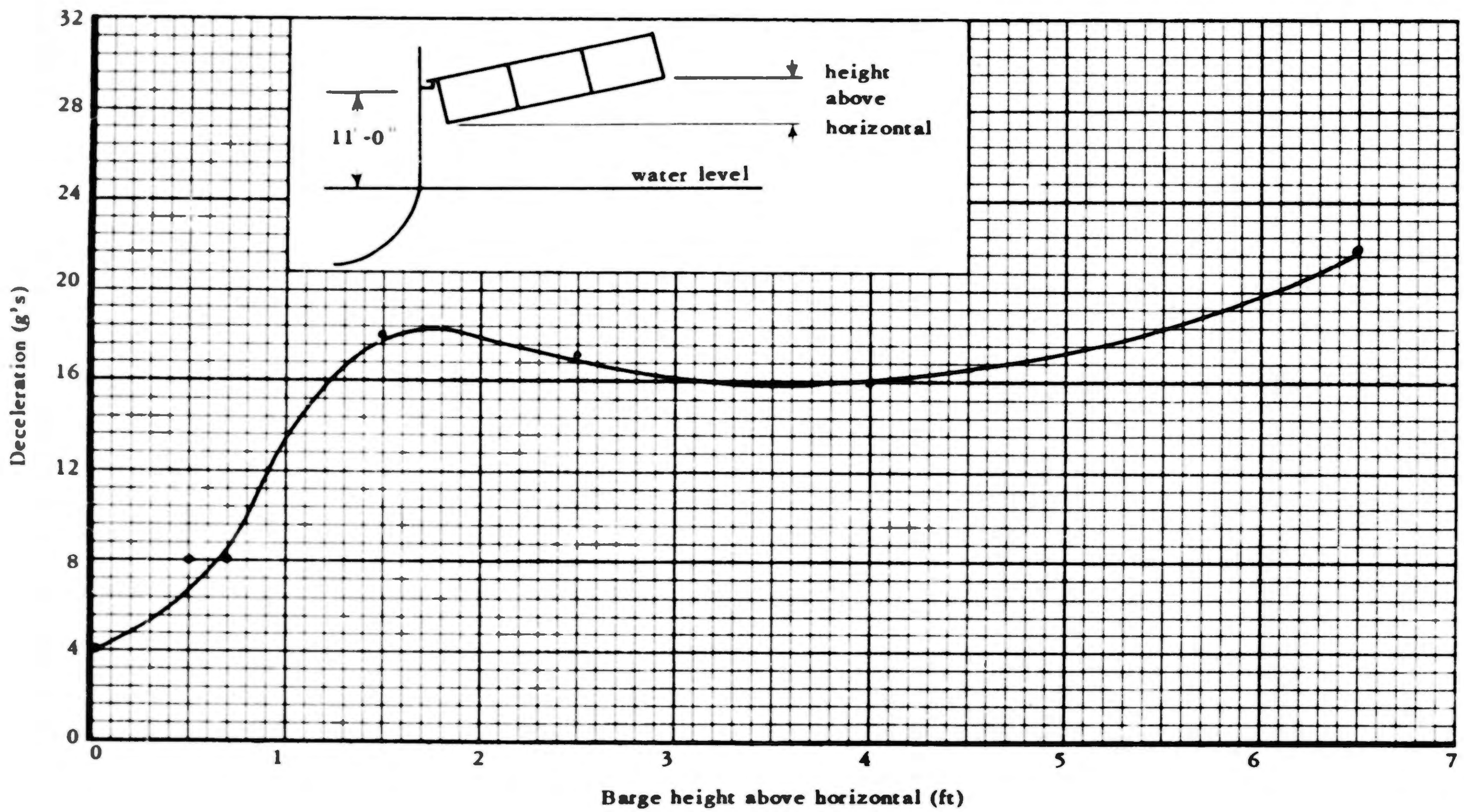

Figure 7. Barge height above horizontal vs deceleration for 3 x 4 barge lowered before launching (rail height, 11 ft).

36 g's (vertical position) to 8 g's (horizontal position) from a 12-ft rail height. Similar reductions in decelerations and damage for the 7-ft and 11-ft launching heights were achieved by lowering the barge before free fall.

A test was made to determine the feasibility of lowering a barge by winch from the vertical position into the water. From a rail height of 11 ft the 3 x 4 section was lowered, utilizing the rear winch of a D-7 tractor (see Figure 8). The bottom of the barge hit the launching frame (see Figure 9) when the outboard single angle was approximately 2 ft below the horizontal. Further lowering of the barge forced the hinge bar out of the rail as the structure rotated about the lower inboard corner. The hinge bar then rubbed against the simulated LST side until the barge entered the water (see Figure 10). The measured deceleration was 6 g's. No damage occurred to the barge or launching frame. This test was repeated from a 12-ft rail height with similar results. The barge was also lowered by winch to a horizontal position at the 12-ft rail height, and then the winch was freewheeled, allowing the barge to freefall. The barge dropped clear of the launching platform and did not rebound into the dock. Deceleration was measured at 8 g's.

3 x 12 Ramp Barge. A 3 x 12 ramp barge was assembled with P-5 plates top and bottom (no links and pins, jewelry, or tie rods). The barge, without propulsion unit, was launched from heights of 0 ft (see Figure 11), 2 ft (see Figure 12), 3 ft and 4 ft. The decelerations measured at the outboard single angle are recorded in Figure 3 and can be seen to correlate closely with the measured decelerations of the 3 x 4 barge from the same heights.

An O2D propulsion unit was mounted over the outboard double angle of a new 3 x 12 ramp barge and the barge was launched from a vertical position at a rail height of 5 ft 4 in. (see Figure 13). No links and pins, jewelry, or tie rods were used in the barge assembly. The damage sustained by the barge from this launching was far in excess of the usual damage from the 6-ft 6-in. launching rail height previously reported.[1] In addition to large indentations in the bottom plates of both the outboard and center strings, there was a bending of the outboard single and double angles (see Figure 14), an A6 bolthead failure (see Figure 15), and failure of several pontoon corner straps as shown in Figure 16. This severe damage is attributed to the flat attitude at which the ramp barge entered the water, resulting in a measured impact deceleration in excess of 100 g's. The bending of the assembly angles was caused by the concentrated load imposed by the O2D propulsion unit.

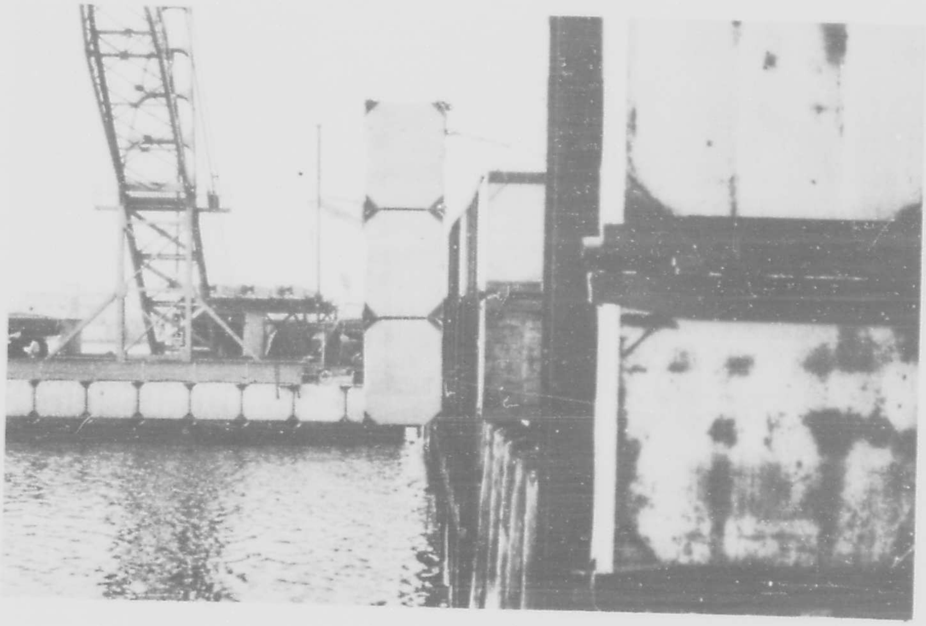

Figure 8. 3 x 4 barge being lowered with winch.

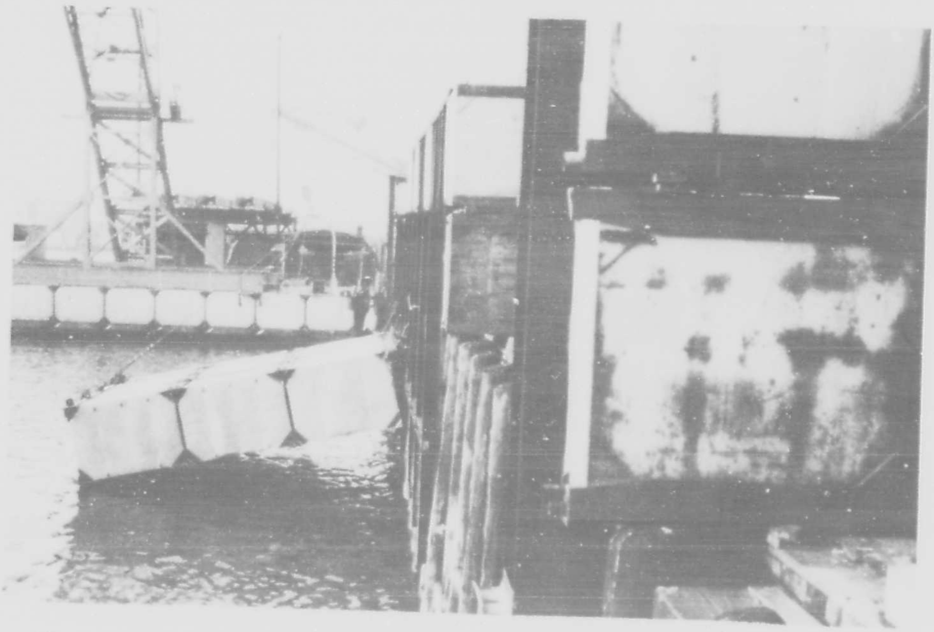

Figure 9. Bottom of 3 x 4 barge striking launching frame during launching.

Figure 10. 3 x 4 barge striking the water while being lowered with winch.

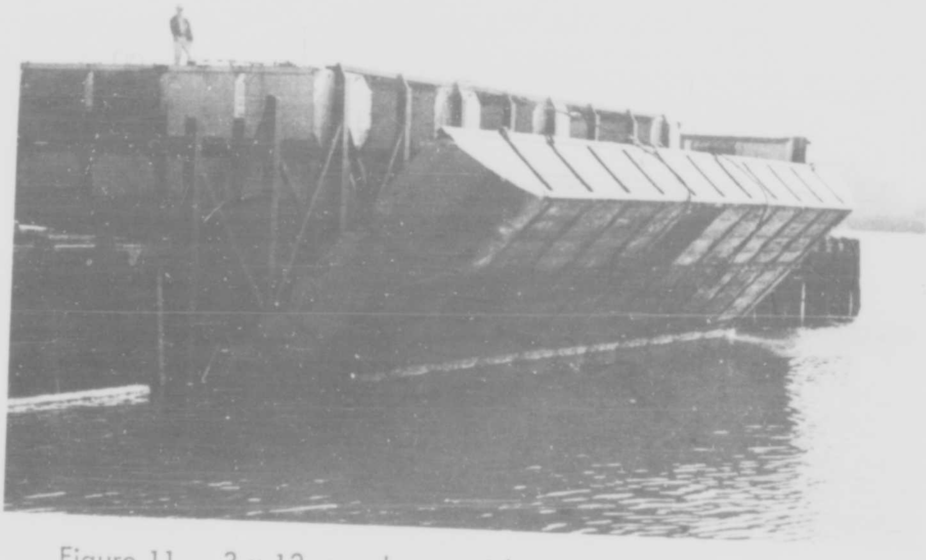

Figure 11. 3 x 12 ramp barge without propulsion unit being launched from 0-ft rail height.

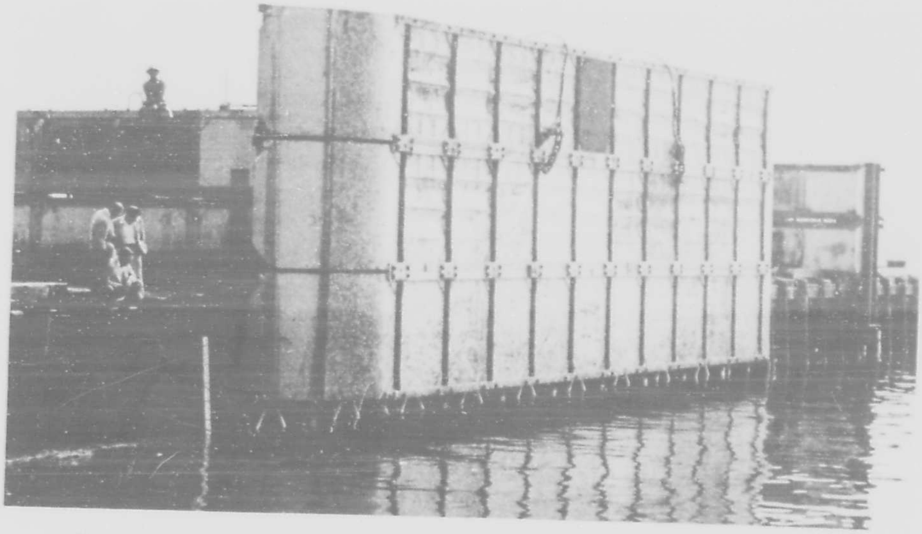

Figure 12. 3 x 12 ramp barge without propulsion unit being launched from 2-ft rail height.

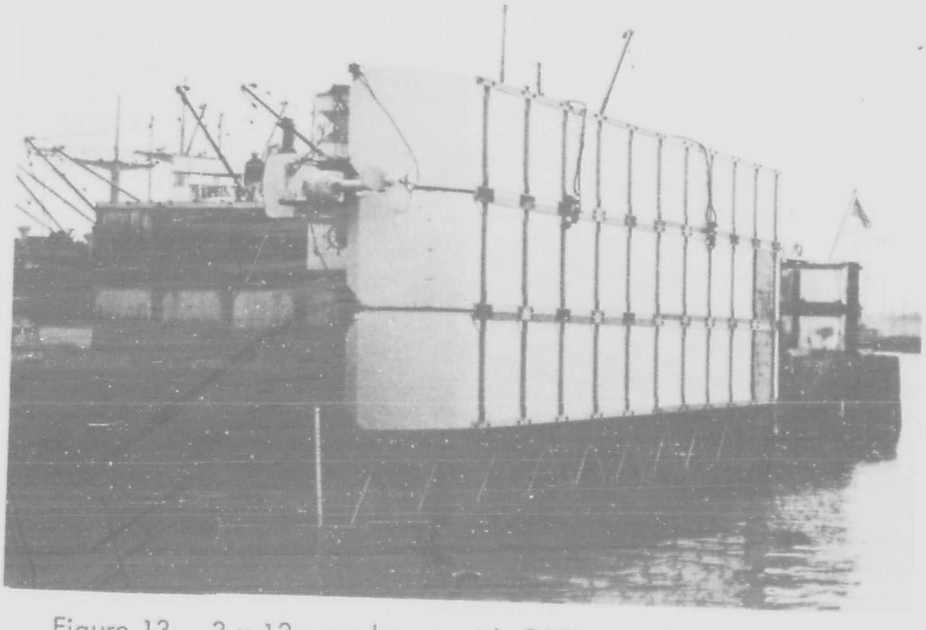

Figure 13. 3 x 12 ramp barge with O2D propulsion unit being launched from 5-ft 4-in. rail height.

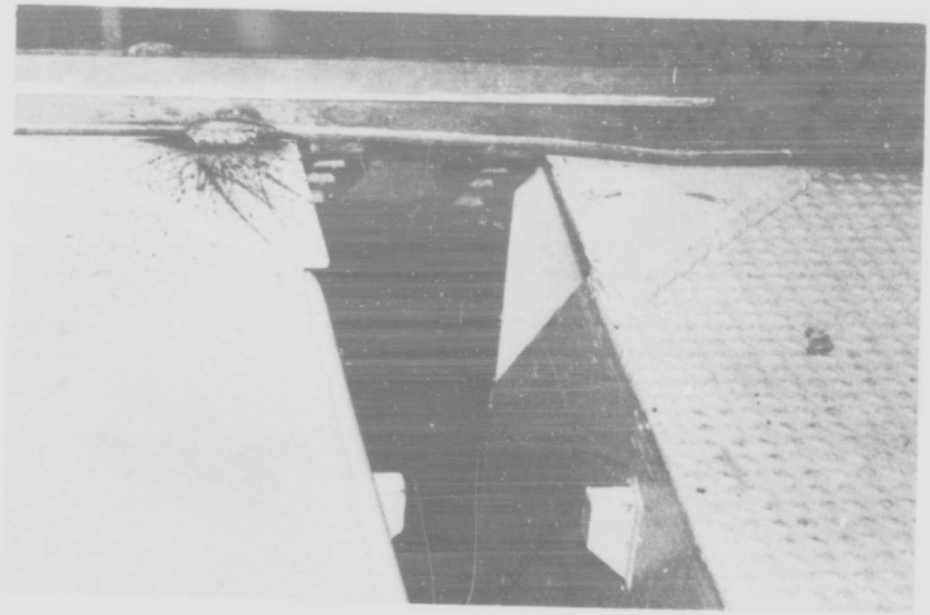

Figure 14. Damaged angle on 3 x 12 ramp barge caused by launching from 5-ft 4-in. rail height.

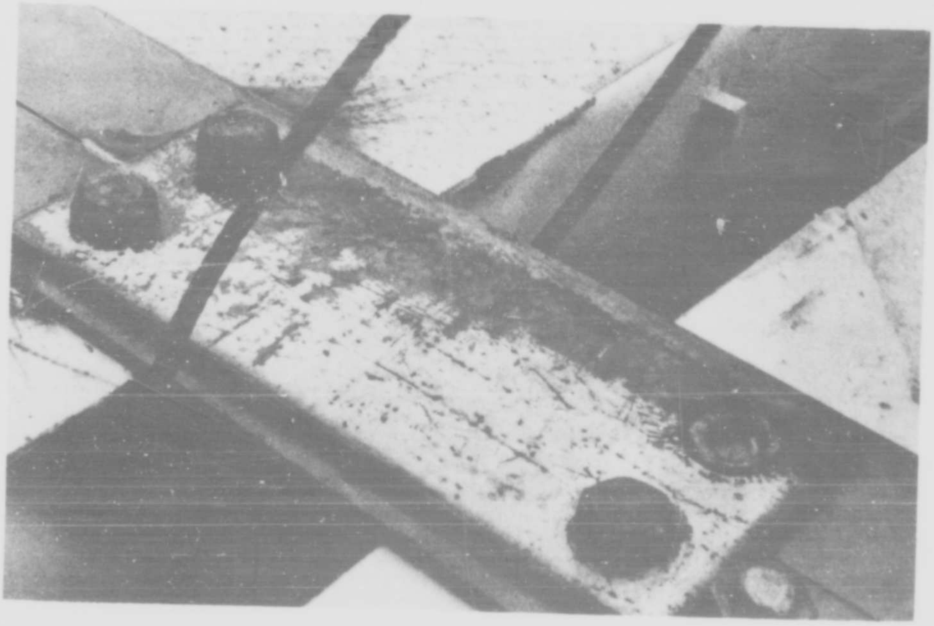

Figure 15. A6 bolt failure on 3 x 12 ramp barge.

Figure 16. Corner strap failure on 3 x 12 ramp barge.

The damaged pontoons were replaced and the 3 x 12 ramp barge with an O2D propulsion unit mounted over the outboard double angles was launched at a rail height of 11 ft from a lowered position at angles of 84-1/2 degrees (outboard deck angle 24 inches above horizontal) and 88-1/2 degrees (outboard deck angle 6 inches above horizontal) from the vertical (see Figure 17). The decelerations measured at the outboard single angle were 16 g's for the 84-1/2 degree angle and 8 g's for the 88-1/2 degree angle. The propulsion unit was operated at the conclusion of these two launchings and inspection of the ramp barge and unit revealed no apparent damage beyond bottom plate indentation. The O2D unit was mounted over the center of the outboard string and launched from a vertical position from rail heights of 11 ft, 12 ft 2 in., and 13 ft, with resulting deceleration readings of 45 g's, 30 g's, and 24 g's, respectively. No damage occurred to the structure except indentation of the pontoon bottom plates.

The 3 x 12 ramp barge was rebuilt and the launching from the 5-ft 4-in. rail height was repeated. An O2D unit was mounted over the center of the outboard string. The resulting damage was similar to

Figure 17. 3 x 12 ramp barge about to be launched from nearly horizontal position (11-ft rail height).

the first 5-ft 4-in. test. The outboard angle was bent, corner straps failed, and the propulsion unit engine mounts failed, resulting in major damage to the unit. The measured deceleration was in excess of 100 g's.

2 x 30 Causeway. A 2 x 30 causeway, assembled with P-5 plates top and bottom and without links and pins, jewelry, or tie rods, was launched from the vertical position at a rail height of 11 ft (see Figure 18). The causeway entered the water at the bottom outboard pontoon angle and the deceleration was measured at approximately 18 g's. The structure cleared the launching rail and did not rebound into the dock.

2 x 4 Test Barge. A 2 x 4 barge section, simulating the 2 x 30 causeway, was launched from the vertical position at a rail height of 11 ft to determine the attitude of entry into the water and impact deceleration. Deceleration measured at the outboard single angle was 20 g's. The 2 x 4 test section entered the water at an angle of approximately 30 degrees between the bottom of the barge and the water surface. Damage to the pontoons was equivalent to that of the 2 x 30 structure launched from the same height. Subsequent launchings made with the

Figure 18. 2 x 30 causeway about to be launched from vertical position (11-ft rail height).

2 x 4 barge were interpreted as 2 x 30 launchings (deceleration, attitude of barge entry into the water, damage, etc.). The 2 x 4 barge was launched in vertical position from rail heights of 7 and 8 ft, and with the barge in lowered position from a rail height of 11 ft. Measured decelerations are recorded in Table I.

TEST RESULTS

All of the above tests were made in calm water and therefore the effect of wave action normally found at sea could not be measured. Rolling of the LST or launching the barge on a wave crest or trough might materially change the launching impact or attitude of barge entry into the water.

Excessive damage from repeated launchings was recorded for all launchings from the vertical position at rail heights from 2 ft through 13 ft. For launchings in which the decelerations are 20 g's or greater, the indentation of the pontoon bottom plates normally amounts to 1/2 inch after the first launching and increases uniformly to approximately 3 inches after six launchings from the same launching rail height. In some instances (the 3 x 12 ramp barge with propulsion unit, for example) damage is excessive after only one launching. The impact decelerations depend upon the structure's entry velocity and entry angle, both of which are functions of the rail height. Greater entry velocities may be endured if the barge enters the water on the corner of the structure rather than striking flat.

As previously stated, the pontoon damage resulting from launchings does not vary directly as the deceleration readings. Measured maximum indentation of the bottom pontoon plates of the 3 x 4 barge was 3/16 inch after six side launchings from a rail height of 1 ft 6 in. Deceleration readings were 6 g's. No leaks occurred in any pontoons. Doubling the rail height to 3 ft resulted in approximately 20 g's deceleration, but the maximum indentation of the pontoon bottom plates after six launchings was approximately 3 inches and several pontoons were leaking after four launchings. From the 11-ft rail height the deceleration readings were approximately 55 g's, while the maximum plate failure was 2 inches after six launchings. The 3 x 4 barge, launched six times from a horizontal position at the 11-ft rail height, had a maximum plate indentation of approximately 1/8 inch and the measured deceleration was 7 g's.

Damage to the pontoons is increased considerably by the addition of a propulsion unit. However, this increased damage is concentrated mainly in the pontoons adjacent to the propulsion unit. In launching the 3 x 12 ramp barge with an O2D unit over the double angle, the maximum bottom plate indentation was 2 inches after one drop. This occurred in the outboard T6B pontoon adjacent to the propulsion unit. The rail height was 5 ft 4 in. and the deceleration was in excess of 100 g's.

The maximum indentation of the bottom plates on a 2 x 30 causeway after six launchings from a height of approximately seven feet was 3-3/8 inches. The deceleration reading for a 2 x 4 barge (which simulates the 2 x 30 causeway) launched from the same height was approximately 45 g's.

In addition, damage to a pontoon structure is not dependent entirely upon the magnitude of the impact with the water but also upon the twisting and bending of the structure as a whole. High-speed motion pictures taken during launchings show a considerable amount of racking in the barges and separation between the strings at the time of impact of the outboard string.

Lowering a pontoon structure through an angle of 90 degrees from the vertical before launching from any rail height up to 13 feet will reduce the pontoon damage to within acceptable limits. Pontoon structures launched in this manner do not strike the LST side while falling nor rebound into it after entering the water. If barges are lowered more than two feet below the horizontal position, the bottom inboard edge will strike the ship's side.

CONCLUSIONS

The damage sustained by pontoon structures during launchings is related to the impact deceleration of the structure but not in direct proportion.

Pontoon damage resulting from launchings may be reduced to acceptable limits or eliminated by lowering the barge to an approximately horizontal position before launchings, by lowering the barge completely into the water from rail heights up to 13 feet, or by lowering the launching rail to within one foot of the water.

Pontoon structures can be lowered to an approximately horizontal position and then allowed to freefall without damage to the LST side.

Launching rail heights which are satisfactory for pontoon structures three strings wide are also satisfactory for structures two strings wide.

Barges can be lowered into the water from a vertical position by winch, or the structures can be lowered to a horizontal position and then allowed to fall free by cutting pendants or by freewheeling the winch. However, the hinge bar will scrape the ship if a structure is completely lowered into the water without permitting free fall after the structure reaches a horizontal position.

RECOMMENDATIONS

It is recommended that damage to side-launched pontoon structures be reduced by lowering the structure from the conventional vertical position to an approximately horizontal position prior to the free fall or by lowering it completely into the water. If the barge structure is lowered into the water, vertical chafing plates, approximately 6 in. wide by 11 ft long, spaced 15 ft to 20 ft centers, would be required to protect the ship's side.

REFERENCES

1. OIC, NAVCERELAB letter, Serial 2451, "Memorandum Report on 3 x 12 Pontoon Barge Side Launching Tests from Simulated Height of Class 1156 LST, Project NY 113 001-5; forwarding of," to Chief, BUDOCKS, 21 January 1955.

2. OIC, NAVCERELAB letter, Serial 3946, "Interim Report No. E-LR-5, Launching Tests of Pontoon Causeways, Project NY 113 001-9.01; forwarding of," to Chief, BUDOCKS, 14 November 1955.

3. NAVCERELAB Technical Memorandum M-106, Development of an Improved Pontoon System, by W.R. Mason and R.C. Towne, 3 August 1955.

DISTRIBUTION LIST

No. of copies	
15	Chief, Bureau of Yards and Docks, Attn: Code D-400
1	Commanding Officer, U. S. Naval Amphibious Base, Attn: Amphibious Construction Battalion No. 1, Coronado
1	Commanding Officer, U. S. Naval Amphibious Base, Attn: Amphibious Construction Battalion No. 2, Norfolk
1	Commanding Officer, Transportation Research and Development Station, Fort Eustis
1	President, Marine Corps Equipment Board, Quantico

NAVY—DPPO 11ND, SAN DIEGO, CALIF.

Naval Civil Engineering Research and Evaluation
Laboratory. Technical Memorandum M-110.
SIDE LAUNCHING OF PONTOON STRUCTURES,
by J. E. Schroeder and R. C. Towne. 31 May 1956.
23 p. illus.

UNCLASSIFIED

Results of tests are given of side launchings from LST ship rail heights up to 13 feet of the following pontoon structures: a 3 x 4 barge, a 3 x 12 barge with and without propulsion unit, a 2 x 4 barge, and a 2 x 30 causeway. These tests proved that damage could be reduced to acceptable limits or eliminated. Winching the barges into the water from the vertical position was found to be the most satisfactory method for reducing this damage.

1. Pontoons--Launching
I. Schroeder, J. E.
II. Towne, R. C.
III. NY 113 001-9

Naval Civil Engineering Research and Evaluation
Laboratory. Technical Memorandum M-110.
SIDE LAUNCHING OF PONTOON STRUCTURES,
by J. E. Schroeder and R. C. Towne. 31 May 1956.
23 p. illus.

UNCLASSIFIED

Results of tests are given of side launchings from LST ship rail heights up to 13 feet of the following pontoon structures: a 3 x 4 barge, a 3 x 12 barge with and without propulsion unit, a 2 x 4 barge, and a 2 x 30 causeway. These tests proved that damage could be reduced to acceptable limits or eliminated. Winching the barges into the water from the vertical position was found to be the most satisfactory method for reducing this damage.

1. Pontoons--Launching
I. Schroeder, J. E.
II. Towne, R. C.
III. NY 113 001-9

Naval Civil Engineering Research and Evaluation
Laboratory. Technical Memorandum M-110.
SIDE LAUNCHING OF PONTOON STRUCTURES,
by J. E. Schroeder and R. C. Towne. 31 May 1956.
23 p. illus.

UNCLASSIFIED

Results of tests are given of side launchings from LST ship rail heights up to 13 feet of the following pontoon structures: a 3 x 4 barge, a 3 x 12 barge with and without propulsion unit, a 2 x 4 barge, and a 2 x 30 causeway. These tests proved that damage could be reduced to acceptable limits or eliminated. Winching the barges into the water from the vertical position was found to be the most satisfactory method for reducing this damage.

1. Pontoons--Launching
I. Schroeder, J. E.
II. Towne, R. C.
III. NY 113 001-9

Naval Civil Engineering Research and Evaluation
Laboratory. Technical Memorandum M-110.
SIDE LAUNCHING OF PONTOON STRUCTURES,
by J. E. Schroeder and R. C. Towne, 31 May 1956.
23 p. illus.

UNCLASSIFIED

Results of tests are given of side launchings from LST ship rail heights up to 13 feet of the following pontoon structures: a 3 x 4 barge, a 3 x 12 barge with and without propulsion unit, a 2 x 4 barge, and a 2 x 30 causeway. These tests proved that damage could be reduced to acceptable limits or eliminated. Winching the barges into the water from the vertical position was found to be the most satisfactory method for reducing this damage.

1. Pontoons--Launching
I. Schroeder, J. E.
II. Towne, R. C.
III. NY 113 001-9