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HEADQUARTERS FIFTEENTH AIR FORCE
Operations Analysis Section
APO 520 U.S. Army

Report No. 19 11 December 1943

BOMBING ATTACKS ON RAILROAD AND HIGHWAY BRIDGES IN ITALY 1 AUG 1943 TO 1 NOV 1943

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ABSTRACT:

Operations of this Command prior to 1 Nov 1943 show that for every bridge that was significantly damaged the average expenditure was

190 sorties attacking
350 tons of bombs dropped

On the basis of this past experience, it can be expected that future operations will require approximately the same expenditure of sorties and bombs for each bridge significantly damaged except for modifications due to improved bombing accuracy.

The results achieved by this Command against enemy bridges are in approximate agreement with bombing accuracy experienced in other theaters of operation.

The marked variations in topography in Italy and the differences in building materials and structural types utilized in Italian bridges cause a great variation in susceptibility to bomb damage and in difficulty of repairing bomb damage. In view of the small number of hits to be expected, a consideration of the above items is necessary when selecting targets in order that each hit obtained is as effective as possible.

The relatively small size of bridges makes them unsatisfactory bombing targets in that a large expenditure of effort is required to damage them. The question as to whether the value of the expected results of attacking certain bridges will outweigh the expected value of dropping that tonnage of bombs on other targets should be considered.

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1. Introduction.

Bombing operations of this Command, prior to 1 Nov 1943, included medium or high altitude attacks on 47 railroad and highway bridges.* This report presents a brief summary of the effort expended and the results achieved by these attacks. A field inspection of bombing results on 11 bridges was made in October 1943.**

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* See Appendix 1
** See Appendix 2

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Aircraft Participating in the Attacks

Heavy Bombers

2nd Bomb Group - B-17 A/C
97th Bomb Group - B-17 A/C
98th Bomb Group - B-24 A/C
301st Bomb Group - B-17 A/C
376th Bomb Group - B-24 A/C

Medium Bombers

17th Bomb Group - B-26 A/C
310th Bomb Group - B-25 A/C
319th Bomb Group - B-26 A/C
320th Bomb Group - B-25 A/C
321st Bomb Group - B-25 A/C
231st Wing - Wellington A/C
236th Wing - Wellington A/C
330th Wing - Wellington A/C
331st Wing - Wellington A/C

II. Successful Attacks.

It was possible to establish the results of the bombing attacks for 35 of the bridges. Bomb hits were obtained on 13 bridges. These were direct hits on the bridges and do not include those instances where hits were obtained on the highway or railroad tracks leading up to the bridges.

TABLE I

Bridges Receiving Direct Bomb Hits

	Sorties	Tonnage	No. of Bombs
Acquapendente	36	66	132
Angitola RR)			
Angitola HW)	299	470	1692
Benevento HW	243	448	1502
Bolzano RR	78	200	399
Cancello Arnone HW)			
(" " RR Br not hit)	188	370	1480
Capua RR)			
Capua New HW)	61	172	726
Capua Old HW)			
Capua HW (3 mi. No.) See Table II)			
Guillianova RR	80	189	460
Orvieto RR (South)	151	285	656
Orvieto RR (North)	95	256	512

(Total 13 bridges)

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TABLE II

Bridges Attacked But Not Hit

	Sorties	Tonnage	No. of Bombs
Albinia	64	138	384
Amorosi RR	58	83	332
Amorosi HW	18	27	108
Angitola pontoon	100	164	656
Antheor Viaduct	53	108	324
Caiazzo, Piano di HW	89	77	529
Cancello Arnone RR (See Table I)			
Capua RR (3 mi. No.)	224	248	1126
(" HW (3 mi. No.) (See Table I)			
Castelvenere HW	36	54	216
Grazzanise HW	30	50	200
Grosseto RR	62	144	288
Grottaminarda HW	54	76	344
Marino di Catanzaro #1)	194	305	1077
Marino di Catanzaro #2)			
Marsciano RR	36	50	100
Montalta di Castro RR	84	159	318
Paola RR	47	69	276
Ponte HW	35	51	202
Porto Civitanova RR	50	65	260
San Martino	36	51	204
Talamone	47	93	372
Terni Viaduct	24	44	88
(Total 22 bridges)			

III. Summary of Operations.

The total effort expended in the attacks on the bridges listed in Tables I and II was

2,451 sorties attacking
4,550 tons of bombs dropped
15,260 bombs dropped

The result of this effort was the destruction or the significant damaging of 13 bridges. The average expenditure for each bridge damaged or destroyed was

190 sorties attacking
350 tons of bombs dropped
1,170 bombs dropped

IV. Probability of Hitting a Bridge.

In a given period of time, a certain number of sorties can be dispatched. Since it can be expected that, on the average, for every 190 sorties one bridge will be hit, it is possible to determine the expected number of bridges that will be damaged in a given operational period. Knowledge of this will enable the effort to be concentrated on the proper number of bridges and will avoid spreading the effort over lower priority targets to the detriment of higher priority targets. As bombing accuracy improves the average number of sorties per bridge will be reduced.

The average group mission for the period 1 August to 1 November 1943 was 30 A/C so that an average of 6-1/3 group missions (190 sorties) was expended for each bridge successfully attacked. This is an average figure so that it can be expected that some bridges will require less than this number of missions and some will require more. The following table gives an indication of the expected variation in number of missions (30 A/C) required.

TABLE III

Probability that the Bridge will be Destroyed by the End of the 1st Mission, 2nd Mission, etc.

By end of	1st	Mission	15.8%	Probability
" "	2nd	"	29.0%	"
" "	3rd	"	40.2%	"
" "	4th	"	49.7%	"
" "	5th	"	57.7%	"
" "	6th	"	64.4%	"
" "	7th	"	70.1%	"
" "	8th	"	74.8%	"
" "	9th	"	78.8%	"
" "	10th	"	82.2%	"

As shown by past experience, highway bridges and railroad bridges are difficult targets for bombers operating at medium or high altitudes. The dimensions of the railroad bridges attacked are of the order of 20 feet by 300 feet. The probability of hitting a target of this size is small unless the bombardment crews have a high degree of accuracy. This is illustrated in Table IV.

TABLE IV

Number of Sorties Required for One Expected Hit on a Target 20 Feet by 300 Feet.*

Measures of Accuracy			
% of Bombs Within 600 ft of Target	% of Bombs Within 1000 ft of Target	Cep	No. of Sorties Required
21%	34%	1500 ft	285
31%	50%	1000 ft	119
58%	82%	500 ft	33

These values indicate that past experience in attacking bridges is in approximate agreement with bombing accuracy experienced in other theaters of operations.** In this Command, the operations were carried out with 81.5 percent of the sorties made by medium bombers. The results obtained were approximately those expected from an accuracy equal to a Cep of 1200 feet. Experience with heavy bombers at high altitudes** has shown an accuracy equal to a Cep of approximately 1500 feet. It is worth noting that if bombing accuracy could be improved to something approaching training school accuracy, such as a Cep of 500 ft, the number of sorties required would be reduced from 190 to 33. This would mean that more than 5 times as many bridges would be destroyed with the same expenditure of effort.

V. Application to Planning of Operations.

In a given operational period let us suppose that there are available for attacking bridges 31 group missions, of 30 A/C each. On the basis of the information available on past experience, that is, that an average of 190 sorties is expended for each bridge successfully attacked, it is expected that these 31 missions will damage or destroy 5 bridges. Therefore, if the success of a certain planned attack requires the destruction of more than 5 bridges, during this operational period, the probability of its success is small. This is illustrated in the following table which shows that the probability of hitting ten bridges is only 1.7%. In order to have a reasonable expectation of success for the planned attack it is necessary to limit the number of bridges required to be destroyed.

* Each sortie dropping 6 bombs in 20 ft. train with Circular Probable Error of 1500, 1000 and 500 ft.

** Bombing Accuracy: May 1943; Report No. 14 and Analysis of Bombing Accuracy: July 1943; Report No. 15 of Operations Analysis Section, H.Q., IX BC.

With Expenditure of 31 Missions

87%	probability	of	successful	attacks	on	at	least	3	bridges
73%	"	"	"	"	"	"	"	4	"
55%	"	"	"	"	"	"	"	5	"
36%	"	"	"	"	"	"	"	6	"
20%	"	"	"	"	"	"	"	7	"
10%	"	"	"	"	"	"	"	8	"
5%	"	"	"	"	"	"	"	9	"
1.7%	"	"	"	"	"	"	"	10	"
0.58%	"	"	"	"	"	"	"	11	"
0.17%	"	"	"	"	"	"	"	12	"
0.05%	"	"	"	"	"	"	"	13	"
0.02%	"	"	"	"	"	"	"	14	"

If the success of the operation does not require the destruction of a specific number of particular bridges, then it is not material how many bridges are attacked. If the effort is spread over 31 bridges, each attacked by a single mission, the expectation is still that 5 will be damaged or destroyed. However, it is impossible to foretell which 5 of the 31 will be successfully attacked. In order to have a reasonable probability of hitting 5 specific bridges, it is again necessary to limit the number of targets.

VI. Susceptibility of Bridges to Bomb Damage.

The type of bridges encountered, listed in the order of frequency of occurrence are

1. Masonry arch bridges.
2. Steel truss and girder bridges.
3. Reinforced concrete bridges.
4. Wood trestle and pontoon bridges.
5. Steel arch bridges.
6. Suspension bridges.

The susceptibility of these various types of bridge to bomb damage depends upon the inherent strength of the bridge, that is, the quality of the engineering design and the quality of the building construction. In addition, it depends on the size, location and number of main supporting

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elements and also upon the structural system utilized.* Inspection of Italian bridges indicates that in general the order of susceptibility to bomb damage** is

1. Wood trestle and pontoon bridges.
2. Reinforced concrete bridges.
3. Masonry arch bridges.
4. Steel truss and girder bridges.
5. Steel arch bridges.
6. Suspension bridges.

Experience during the period 1 Aug 43 to 1 Nov 43 has been that of the bridges that were successfully attacked, 8 received rather serious damage and 4 were not so seriously damaged.

Bridges Not Seriously Damaged

Angitola RR bridge. Steel truss.
Capua RR bridge. Steel plate girder.
Orvieto RR bridge. Steel truss.
Benevento HW bridge. Masonry arch.

Bridges Seriously Damaged

Angitola HW	Masonry bridge
Cancello Arnone HW	Masonry bridge
Capua HW, 3 miles North	Masonry bridge
Capua Old HW	Masonry bridge
Orvieto RR, North	Masonry bridge
Capua New HW	Reinforced concrete bridge
Bolzano RR	Steel bridge
Guilliano va RR	Steel bridge

This shows that 40% of the steel bridges that were hit received serious damage and 83% of the masonry bridges were seriously damaged.

The variation in susceptibility to bomb damage is a factor of

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* As an example, the suspension bridge has a low susceptibility. It has only two main supporting elements, the suspension cables and the towers. These elements are relatively small and have high strength. The quality of design and construction is usually very good. Serious damage, other than destroying the deck, can be done only by cutting the suspension cables or destroying the towers.

** This will vary in individual cases and each bridge should be judged on its own merits.

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sufficient importance to warrant careful consideration when selecting targets. This variation will also govern the optimum size and fuzing of the bombs and the optimum altitude of attack. Because of the small probability of obtaining hits on a bridge it is desirable to carry a maximum number of bombs per sortie to increase the probability. The factor that will govern the number of bombs to be carried is the susceptibility of the bridges to damage. This will determine the smallest size of bomb that will cause satisfactory damage. The fuzing of the bomb and the altitude of attack are governed by the necessity for obtaining detonation of the bomb at that elevation which will cause the greatest damage. It is apparent that the wide variation encountered in Italian bridges will have a marked effect on the optimum methods of attack. The Operations Analysis Section, Fifteenth Air Force, is prepared to assist in bridge target selecti n and tactics for this Command.

VII. Difficulty of Maintaining Traffic Over Damaged Bridges.

The difficulty of repairing a bomb damaged bridge sufficiently to maintain traffic varies greatly with individual bridges. It is not possible to give a complete generalization but the following items give some of the cases of importance.

More Difficult to Repair	Less Difficult to Repair
Bridge at high elevation above stream bed.	Bridge at low elevation above stream bed.
Water in the stream bed.	Stream bed dry.
Long span bridges.	Short span bridges.
Arch bridges.	Girder and truss bridges.

Selection of targets should be influenced by considerations of traffic maintenance. When only a limited number of bridges can be expected to be destroyed in a certain period of time it is desirable to have each bomb hit achieve a maximum interruption of traffic.

VIII. Suitability of Bridges as Bombing Targets.

In view of the present status of bombing accuracy, bridges are not satisfactory targets. The small dimensions of a bridge make the probability of obtaining a hit small. In addition, the isolated location of the usual bridge makes the near misses worthless as there is nothing of military significance in the neighborhood of the bridge. On the basis of present bombing accuracy, the most suitable target is one having dimensions of the order of 1000 feet. With such targets, a reasonably large percentage of bombs will fall in the target area and will be in a position to do significant damage. It was this factor that made the attacks on the railroad marshalling yards in Italy so successful. In particular, the success of the attacks on the Naples marshalling yard was due to the fact that the target area was large enough so that many hits were obtained on the target and the near misses caused severe

damage to the industrial zone surrounding the target. In view of the large expenditure of effort required to damage a bridge, the question as to whether the value of the expected results will outweigh the required expenditure is of importance. An example of this is the series of attacks made on the 14 bridges over the Volturno and Calore Rivers. A total of 966 sorties and 1617 tons of bombs were expended. Damage extensive enough to halt traffic was caused to five bridges. The other 9 bridges plus an additional temporary bridge at Castel Volturno were still serviceable. The expenditure of 1617 tons of bombs was profitable only if the five bridges destroyed, plus incidental damage, had a value, strategic or tactical, greater than the value of 1617 tons of bombs dropped on some other target.

This is not intended to be an indictment of the U.S. Air Force technique of bombing. Excellent results are obtainable with this technique as has been demonstrated many times. However, as long as bombing accuracy is being improved, we should be aware of both the capabilities and limitation of our technique. We must recognize that combat bombing has not yet achieved training school accuracy. In order to use bombardment operations most efficiently, planning should be based on present accuracy and not on the accuracy obtained in training schools.

IX. Use of Delay-Action Fuzes Against Bridges.

Attacks were made on the highway bridge at Ponte with some of the bombs fuzed for delayed action. It had been planned that the attacks would destroy the bridge and that the detonation of the delayed-action bombs would delay the repair of the bridge. The attacks were not successful.

Attacks on Ponte Highway Bridge

24 Sep 43; 18 B-25; 310 BG; 26½ tons of 500 lb bombs
25 Sep 43; 17 B-26; 319 BG; 24 tons of 500 lb bombs

Total 35 sorties 50½ tons of bombs

In view of the fact that an average of 190 sorties and 350 tons of bombs were required for each bridge successfully hit, the attack on the Ponte Bridge was on too small a scale to warrant a reasonable expectation of success. For such an attack it would be necessary to plan on approximately 120 sorties in order to have a 50% certainty of succeeding.

An additional factor tending to reduce the chance of success of the attack on the Ponte Bridge was the nature of this particular bridge. It was a steel arch bridge of approximately 140 ft span with all of the arch below the deck. The main supporting members of the bridge, the arch ribs, were small in size, had great strength and were at a varying elevation below the deck of the bridge. These factors made the Ponte Bridge much less susceptible to serious bomb damage than the average Italian bridge.

X. Demolition of Bridges by the Enemy.

As a matter of record, it is here noted that when the German army has evacuated a region, such as the Volturno River Valley, all bridges are demolished. The demolition is very thorough. Not only is it aimed at stopping traffic, but it is done in such a manner as to make it most difficult to repair the bridges.

XI. Conclusions.

A. Operations of this Command prior to 1 Nov 43 show that on the average one bridge was significantly damaged for every 190 sorties flown and every 350 tons of bombs dropped in attacks against bridges.

B. The results achieved by this Command against enemy bridges are in approximate agreement with bombing accuracy experienced in other theaters of operation.

C. Because of the marked variations in topography in Italy and because of the different building materials and structural types utilized in Italian bridges, there is a great variation in susceptibility to bomb damage and in difficulty of repairing bomb damage. In view of the relatively small number of hits to be expected, consideration of the above items when selecting targets is important in making each hit count for the most.

D. The relatively small size of bridges makes them unsatisfactory bombing targets in that a large expenditure of effort is required to damage them. The question as to whether the value of the expected results of attacking certain bridges will outweigh the expected value of dropping that tonnage of bombs on other targets should be considered.

This study made by G. W. Housner.

S. G. FRANTZ
Section Chief

LEGIBILITY POOR

APPENDIX 1

Bridges Attacked Durin. The Period 1 Aug 1943 To 1 Nov 1943
(Statistics Compiled From INTOPS, H.Q., 15 AF)

M 1. Acquapendente.
21 Oct 1943; 36 B-26; 319 BG; 66 tons 1000 lb bombs.

2. Albinia.
H 21 Oct 1943; 28 B-17; 2 BG; 84 tons 1000 lb bombs.
23 Oct 1943; 36 B-25; 310 BG; 54 tons 500 lb bombs.

3. Amorosi RR.
22 Sep 1943; 24 B-26; 319 BG; 32 tons 500 lb bombs.
M 24 Sep 1943; 18 B-26; 320 BG; 27 tons 500 lb bombs.
29 Sep 1943; 16 B-25; 310 BG; 24 tons 500 lb bombs.

4. Amorosi HW.
M 30 Sep 1943; 18 B-25; 310 BG; 27 tons 500 lb bombs.

5. 6. Angitola RR and Angitola HW.
7 Aug 1943; 36 B-26; 320 BG; 72 tons 1000 lb bombs.
7 Aug 1943; 35 B-26; 319 BG; 70 tons 1000 lb bombs.
8 Aug 1943; 36 B-26; 319 BG; 52½ tons 500 lb bombs.
M 8 Aug 1943; 36 B-26; 320 BG; 48 tons 500 lb bombs.
9 Aug 1943; 37 B-26; 17 BG; 55½ tons 500 lb bombs.
9 Aug 1943; 39 B-26; 319 BG; 54 tons 500 lb bombs.
11 Aug 1943; 45 B-25; 310 & 321 BG; 63.5 tons 500 lb bombs.
18 Aug 1943; 36 B-25; 321 BG; 54 tons 500 lb bombs.

7. Angitola pontoon.
M 16 Aug 1943; 24 B-26; 319 BG; 36 tons 500 lb bombs.
17 Aug 1943; 38 B-26; 17 BG; 48-1/4 tons 500 lb bombs.
18/19 Aug 1943; 38 Wellingtons; 236, 330 Wings; 80 tons mixed bombs.

8. Antheor Viaduct.
H 31 Oct 1943; 38 B-17; 99, 301 BG; 108 tons 500 & 1000 lb bombs.

9. Benevento HW.
12 Sep 1943; 19 B-17; 2 BG; 57 tons 500 lb bombs.
16 Sep 1943; 68 B-17; 99, 301 BG; 102 tons 500 lb bombs.
20 Sep 1943; 39 Wellingtons; 236, 331 Wings, 72 tons mixed bombs.
H 21 Sep 1943; 33 B-17; 97 BG; 96 tons 1000 lb bombs.
20/21 Sep 1943; 50 Wellingtons; 330, 331 Wings; 72 tons mixed bombs.
M 24 Sep 1943; 34 B-25; 321 BG; 49 tons 1000 lb bombs.

10. Bolzano RR.
25 Sep 1943; 14 B-17; 301 BG; 35 tons 1000 lb bombs.
H 4 Oct 1943; 64 B-17; 2, 97, 301 BG; 164.5 tons 1000 lb bombs.

11. Caiazzo, Piano di HW.
25 Sep 1943; 18 B-26; 17 BG; 26 tons 300 lb bombs.
29 Sep 1943; 29 B-25; 321 BG; 43 tons 500 lb bombs.
30 Sep 1943; 36 B-25; 321 BG; 46 tons 500 lb bombs.

12, 13. Cancello Arnone RR and Cancello Arnone HW.
9 Sep 1943; 60 B-17; 2, 301 BG; 180 tons 500 lb bombs.
21 Sep 1943; 36 B-26; 320 BG; 54 tons 500 lb bombs.
23 Sep 1943; 18 B-26; 320 BG; 27 tons 500 lb bombs.
24 Sep 1943; 18 B-26; 320 BG; 26 tons 500 lb bombs.
25 Sep 1943; 38 B-26; 320 BG; 56.5 tons 500 lb bombs.
29 Sep 1943; 18 B-26; 319 BG; 26 tons 500 lb bombs.

14, 15, 16. Capua. One RR, two HW bridges.
9 Sep 1943; 61 B-17; 97, 99 BG; 172 tons 500 & 1000 lb bombs.

17, 18. Capua. One RR, One HW, 3 miles NE Capua.
16 Sep 1943; 53 B-25; 310 BG; 61 tons 300 lb bombs.
21 Sep 1943; 36 B-25; 310 BG; 43 tons 300 lb bombs.
23 Sep 1943; 18 B-26; 319 BG; 23.5 tons 300 lb bombs.
30 Sep 1943; 33 B-26; 319 BG; 47 tons 500 lb bombs.
3 Oct 1943; 36 B-26; 319 BG; 51 tons 500 lb bombs.

19. Castelvenere HW.
29 Sep 1943; 18 B-25; 310 BG; 27 tons 500 lb bombs.
30 Sep 1943; 18 B-25; 310 BG; 27 tons 500 lb bombs.

20. Grazzanise HW.
1/2 Oct 1943; 30 Wellingtons; 231, 236, 330 Wings, 50 tons mixed bombs.

21. Grosseto RR.
20 Oct 1943; 26 B-24; 98 BG; 72 tons 1000 lb bombs.
22 Oct 1943; 36 B-25; 310 BG; 52.5 tons 1000 lb bombs.

22. Grottaminarda HW.
22 Sep 1943; 36 B-25; 321 BG; 49.5 tons 500 lb bombs.
24 Sep 1943; 18 B-25; 310 BG; 27 tons 500 lb bombs.

23. Guillianova RR.
21/22 Oct 1943; 47 Wellingtons; 231, 236 Wings, 82 tons mixed bombs.
14 Oct 1943; 33 B-17; 310 BG; 107 tons 500 lb bombs.

24, 25. Marina di Catanzaro. Two RR bridges.
4 Aug 1943; 51 B-26; 17, 319 BG; 70½ tons 500 lb bombs.
7 Aug 1943; 36 B-26; 17 BG; 77 tons 1000 lb bombs.
8 Aug 1943; 36 B-25; 310 BG; 53 tons 500 lb bombs.
9 Aug 1943; 36 B-25; 310 BG; 52-1/4 tons 500 lb bombs.
11 Aug 1943; 35 B-26; 319 BG; 52½ tons 500 lb bombs.

26. Marsciano RR.
23 Oct 1943; 36 B-26; 319 BG; 50½ tons 1000 lb bombs.

27. Montalta di Castro RR.
20 Oct 1943; 36 B-26; 319 BG; 70 tons 1000 lb bombs.
21 Oct 1943; 36 B-26; 320 BG; 65 tons 1000 lb bombs.
23 Oct 1943; 12 B-26; 320 BG; 24 tons 1000 lb bombs.

28. Orvieto RR (North).
21 Oct 1943; 32 B-17; 99 BG; 93 tons 1000 lb bombs.
21 Oct 1943; 39 B-24; 98, 376 BG; 120½ tons 1000 lb bombs.
22 Oct 1943; 24 B-26; 319 BG; 42½ tons 1000 lb bombs.

29. Orvieto RR (South).
20 Oct 1943; 32 B-17; 2 BG; 93 tons 1000 lb bombs.
20 Oct 1943; 36 B-26; 320 BG; 64.5 tons 1000 lb bombs.
22 Oct 1943; 24 B-26; 320 BG; 43 tons 1000 lb bombs.
24 Oct 1943; 24 B-26; 320 BG; 43 tons 1000 lb bombs.
24 Oct 1943; 35 B-25; 310 BG; 42 tons 1000 lb bombs.

30. Paola RR.
4 Aug 1943; 47 B-25; 321 BG; 69 tons 500 lb bombs.

31. Ponte HW.
24 Sep 1943; 18 B-25; 310 BG; 26½ tons 500 lb bombs.
25 Sep 1943; 17 B-26; 319 BG; 24 tons 500 lb bombs.

32. Porto Civitanova RR.
22/23 Oct 1943; 50 Wellingtons; 330, 231 Wings;
65 tons mixed bombs.

33, 34. Pescara Br, Porto San Giorgio Br, Guillianuva Br.
14 Oct 1943; 36 B-24; 98, 376 BG; 110.5 tons 1000 lb bombs.

35. San Martino.
22 Sep 1943; 36 B-25; 321 BG; 51 tons 500 lb bombs.

36, 37, 38. Sapri. One RR, two HW Br.
7 Sep 1943; 106 B-26; 17, 319, 320 BG; 157.5 tons 500 lb bombs.
8 Sep 1943; 105 B-26; 17, 319, 320 BG; 153 tons 500 lb bombs.

39. Talamone.
14/15 Oct 1943; 47 Wellingtons, 330, 236 Wings, 93 tons mixed bombs.

40. Terni Viaduct. RR.
24 Oct 1943; 24 B-26; 319 BG; 44 tons 1000 lb bombs.

41 - 46. Trebbisacce. Three HW, three RR Br.
7 Sep 1943; 32 B-25; 310 BG; 48 tons 500 lb bombs.
8 Sep 1943; 36 B-25; 310 BG; 53.5 tons 500 lb bombs.

47. Vinchiatura RR.
29 Sep 1943; 7 B-25; 321 BG; 10.5 tons 500 lb bombs.

APPENDIX 2

Inspection Of Bridges In Italy, October 1943

1. Benevento Highway Bridge. Multi-span masonry arch bridge. A very large number of bomb craters were visible in the immediate vicinity of the bridge. The portion of the city adjacent to the bridge was completely demolished. One bomb hit had been obtained on the center of one arch. One half of the arch was destroyed but traffic was maintained over the other half. Subsequent to 20 October, an additional portion of the damaged arch collapsed. This completely stopped traffic over the bridge.

2. Capua Railroad Bridge. This bridge was a multi-span, single track, through plate girder bridge. The steel plate girders had a span of about 100 feet and a depth of 7 feet. The bridge was completely demolished by the Germans. The two center (masonry) piers were destroyed, and the steel bridge itself had been mangled by demolition charges so as to make it impossible to re-use the girders. The demolition of this bridge was so complete that it was impossible to tell whether it had received any bomb damage. Only a few scattered craters were seen in the near vicinity of the bridge. Reconnaissance photos show one hit on the center of bridge obtained on 9 September 1943. At this date, the bridge was still standing but one girder was damaged.

3. Capua Highway Bridge (New). This was a two lane, continuous, three span, reinforced concrete, girder bridge. The end spans were approximately 110 feet and the center span 130 feet. The thickness of the beams at mid-span was 5 feet and at the supports 13 feet. The bridge was continuous over the supports with a suspended center span. The two center piers had been demolished by the Germans and the entire bridge dropped into the river bed. Only two bomb craters were found in the near vicinity of the bridge (about 500 feet away). Reconnaissance photos show that on 9 Sep 1943, a hit was obtained over the first interior support on the south end of the bridge. This hit dropped the south span of the bridge into the river.

4. Capua Highway Bridge (Old). The easterly bridge at Capua was an old masonry arch bridge. This had been so completely demolished that no recognizable fragments remained. Only one crater was seen in the near vicinity of the bridge. The reconnaissance photos show that on 9 Sep 1943, the south arch of the bridge was destroyed by a bomb hit.

5. Castel Volturno Highway Bridge. This was stated by the natives to have been a low timber bridge constructed by the Germans about one-half mile west of town and to have been completely destroyed by the Germans. The inhabitants of the town stated that no bombs fell near the bridge and that it was in continual use by the Germans until they evacuated to the north side of the river. The town of Castel Volturno had received considerable bomb damage. The small ferry across the river was still in operation.

6. Grazzanise Highway Bridge. Low timber bridge on closely spaced piles, located at the edge of the town. There was no evidence of bomb hits near the bridge. The town, however, was damaged by bombing. The bridge had been demolished by the Germans. Photo reconnaissance of 1 October 1943 shows the bridge intact. The bridge was erected by the Germans between the dates of 23 September and 30 September 1943.

7. Piano di Caiazzo Highway Bridge. Low timber bridge on closely spaced piles. Nothing remains of this bridge except the tops of the piles projecting out of the water. There are bomb craters near the approaches of the bridge on both banks of the river and numerous craters in the general vicinity of the bridge. It was not possible to ascertain whether the bridge had sustained any bomb damage. Photo reconnaissance of 30 September 1943 shows the bridge intact.

8. Amorosi Highway Bridge. Multi-span, masonry arch bridge. The two central spans over the river were demolished by the Germans. There was no evidence of bomb damage to the bridge and there were no bomb craters in the immediate vicinity of the bridge. It was stated by the natives that no bombs had struck the bridge and that some bombs had landed in the hills to the north and others had struck about one mile west of the bridge. Photo reconnaissance of 30 September shows the bridge intact.

9. Amorosi Railroad Bridge. Multi-span masonry arch bridge carrying both the highway and a single track railway line. Seven bomb craters were seen in the general vicinity of the south end of the bridge. There was no evidence of bomb damage to the bridge. It was also stated by the natives that no bombs hit the bridge. Two spans of this bridge were demolished by the Germans. Photo reconnaissance of 30 September shows this bridge intact.

10. Castelvenere Highway Bridge. Steel suspension bridge of about 140 feet span. There was no evidence of bomb damage. Three bomb craters were seen in the general vicinity of the bridge. The bridge had been dropped into the river by the Germans. Photo reconnaissance of 30 September showed the bridge intact.

11. Ponte Highway Bridge. Steel arch bridge of about 150 feet span. Fifteen bomb craters were visible, located at from 40 to 1000 feet from the bridge. There was no evidence of bomb damage. The steel arch has been demolished by the Germans. Photo reconnaissance of 30 September shows bridge intact. Some delay action bombs had been used in the attack on this bridge. One of these bombs struck the bridge abutment (photo recon). There was no evidence of bomb damage to the abutment.

APPENDIX 3

Method of Classifying Successful Attacks

The determination of the successful attacks on bridges was made on the basis of INTOPS and inspection of reconnaissance photos. When suitable, reconnaissance photos were used when available. When no suitable photos were available and INTOPS reported no hits, the attack was classed as unsuccessful. The resulting statistics are not claimed to be exact. They are, however, probably conservative as all the bridges that are listed as receiving direct hits were seen in reconnaissance photos to be in a damaged condition. There is a possibility that two of the bridges listed in Table II should be in Table I. Due to inexact designations of targets attacked, there is also the possibility that some of the missions against bridges have not been included. In several cases, attacks were made on localities where a railroad bridge and a highway bridge were not far apart. When no definite statement was available, it was assumed that the railroad bridge was the target. The statistics incorporated in the report are thought to be correct to within 15%.

RR Bridge 9½ miles south of Orvieto. Shadow shows repair

CONFIDENTIAL

18

80

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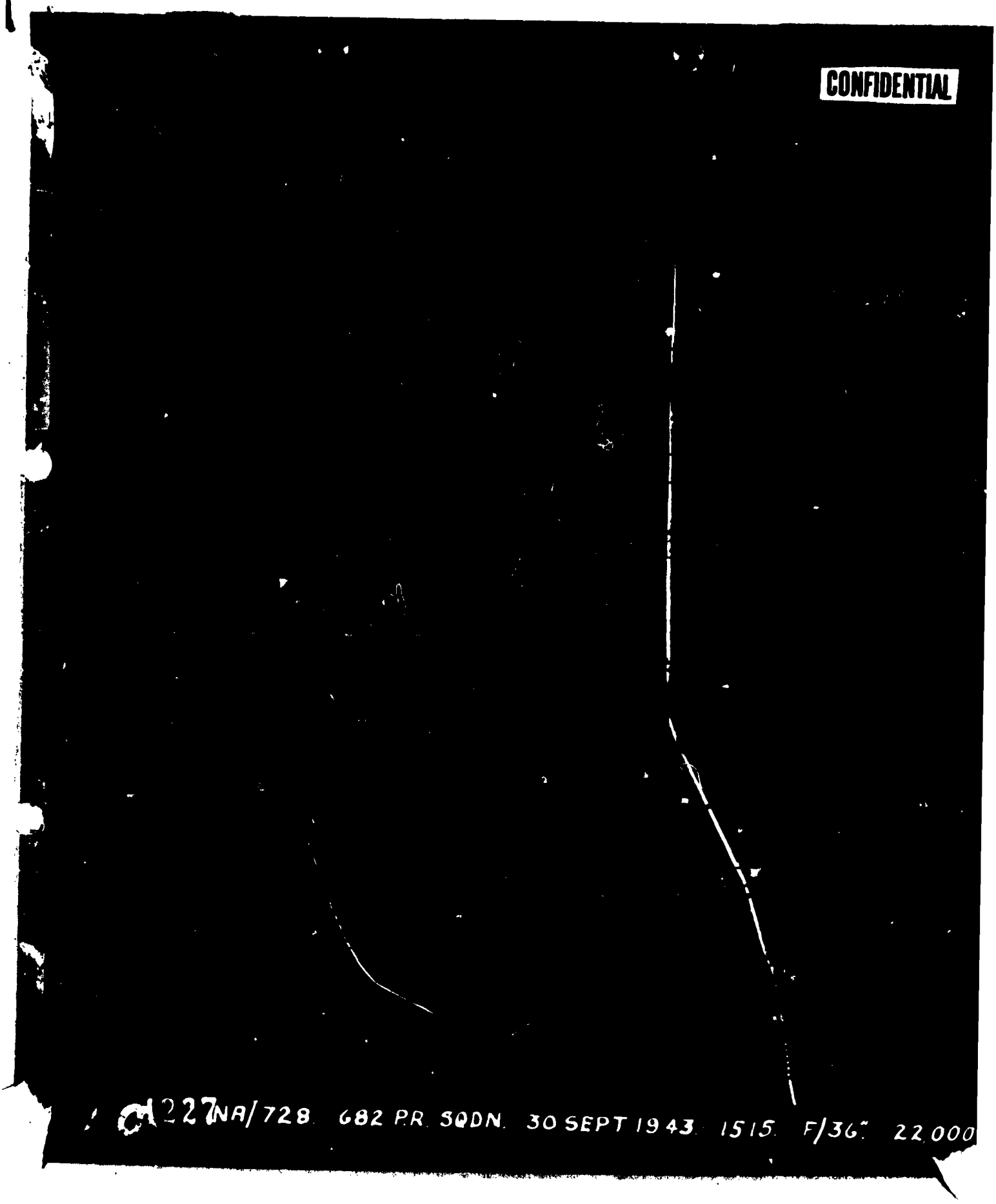
1 RR and 2 HR Bridges at Capua. Hits obtained on all three bridges.



RR and HW bridge South of Amoroni.

CONFIDENTIAL

Bridge at Piano di Caiazzo

CONFIDENTIAL

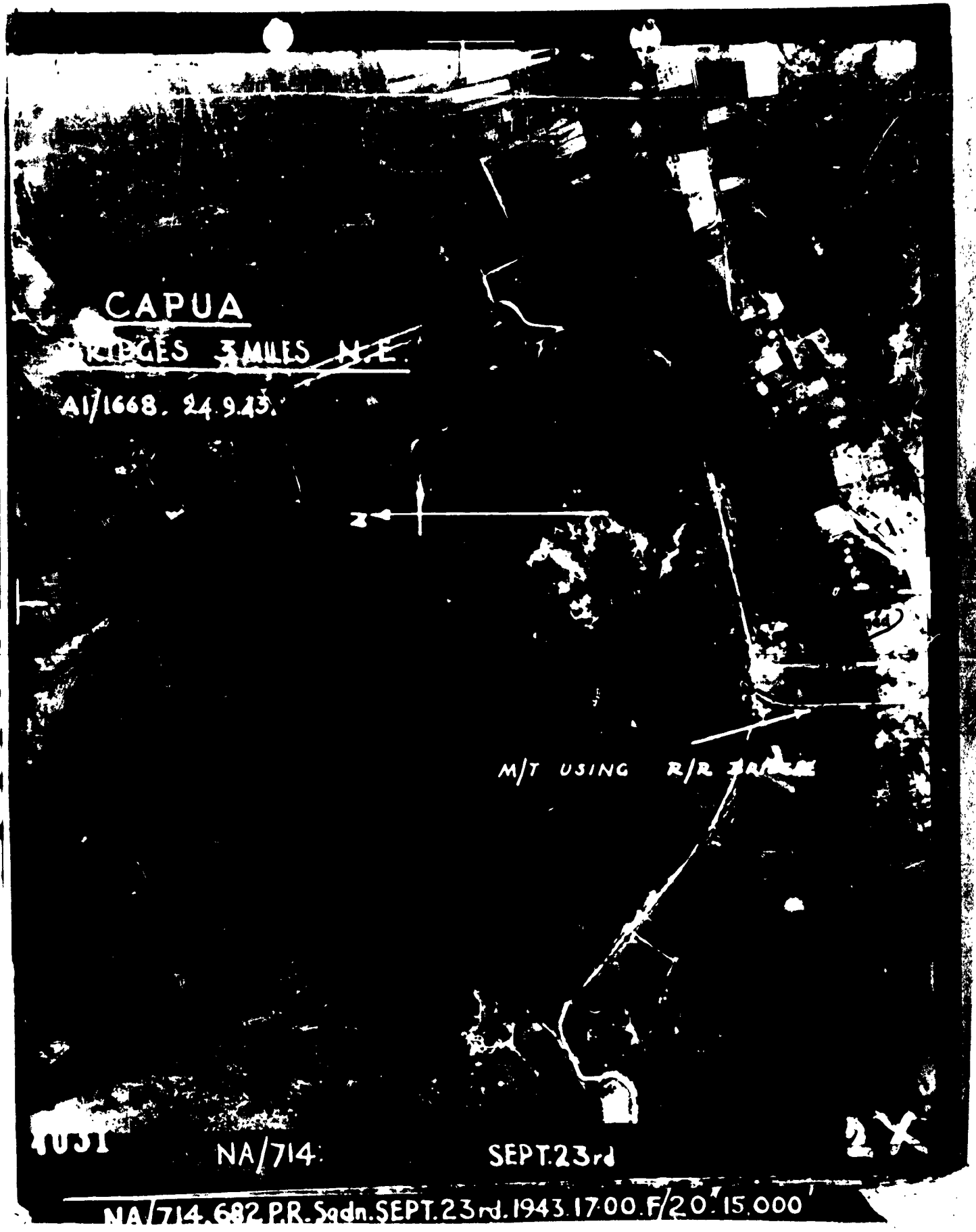
83

21

Grosseto RR Bridge, 249 1000 lb bombs dropped.

22

84



CONFIDENTIAL

Highway Bridge destroyed by bombing, transport using RR bridge.

65

CONFIDENTIAL

RR Bridge 9½ miles south of Orvieto. Shadow of bridge shows destruction of some bridge members. Subsequent repairs made this bridge serviceable.

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DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

23 June 2010

HAF/IMIO (MDR)
1000 Air Force Pentagon
Washington, DC 20330-1000

Bobby Sammons.
P.O. Box 1680
Cloudcroft, NM 88317-1680

Dear Mr. Sammons

Reference to your letter, undated (attachment 1) requesting a Mandatory Declassification Review (MDR) for Defense Technical Information Center (DTIC) documents:

AD004521	AD005224
AD005736	AD005735
AD006796	AD004876
AD005809	AD003234
AD005808	AD004232

The review for the documents have been completed and the declassification has been downgraded to UNCLASSIFIED and copies are attached for your information.

Address any questions concerning this review to the undersigned at (703) 692-9979 and refer to our case number 07-MDR-076.

Sincerely

JOANNE MCLEAN
Mandatory Declassification Review Specialist

2 Attachments
1. Letter, Request for Documents
2. 10 DTIC Documents

cc: DTIC w/o documents