

## Were there submarines in the New Forest during the Second World War?

An investigation into the purpose of the large concrete structure built on the Ashley Walk Bombing Range during 1941. Was it in fact a replica of German submarine pens or was it something else?

**Background:** The Verderers of the New Forest gave their formal consent to the construction of Ashley Walk Bombing range on 13 February 1940. The Range comprised approximately 5000 acres of land, all of which was fenced off with a 6ft high chain link fence 9 miles long. It was accessed by 13 double gates. The range lies to the south of the Fordingbridge/Cadnam Road and can be accessed from Ashley Walk or Godshill Cricket Pitch car parks. The Range was part of the Aeroplane and Armament Experimental Establishment based at Boscombe Down. The administration and accommodation areas were opposite the Fighting Cocks public house at Godshill where the outlines of the building bases can still be seen.

The purpose of the range was to test all types of experimental air delivered weapons with the exception of incendiary devices. Many weapons were tested, the most famous being versions of Barnes Wallace's 'bouncing bombs' and the 22000lb Grand Slam bomb.

A full description of the range is given in 'Ashley Walk – Its bombing range, landscape and history' by Anthony Pasmore and Norman Parker. It is recommended that anyone wishing to explore the range obtains this publication. Many large structures were constructed as targets, including a large reinforced concrete building built for the Ministry of Home Security and known due to its shape as the 'submarine pens.' For ease, the Ministry of Home Security Target will be referred to by its more common name of the submarine pens or sub pens in this report. The Range closed in 1946

**The Submarine Pens:** This structure of reinforced concrete was built to the south of Pitts Wood. It comprised a concrete slab 79 feet by 70 feet by 6 feet thick supported by 5



Fig 1 Sub Pens 2012

unequally spaced walls 6 feet in height and being open at two ends. The whole structure was built on a reinforced concrete slab. After the closure of the Range in 1946 the structure was covered in earth rather than demolished. In fact this covered structure has caused confusion over the years as it is shown on the current OS map as a tumulus. There is, in fact, a tumulus about 150 metres west of the sub pens which survived the war but shows clearly on pre-war maps in its correct position. It was surveyed by Heywood

Sumner and LV Grinsell at different times.

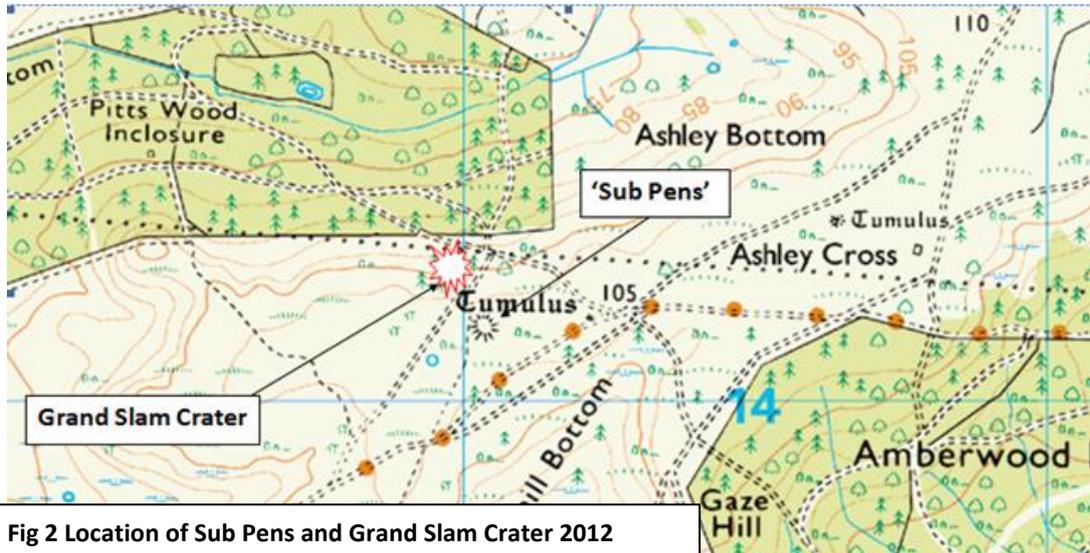


Fig 2 Location of Sub Pens and Grand Slam Crater 2012

Until recently there were only two known photographs of the sub pens and one is shown in **Fig 3**. The structure is at the top left of the photo and clearly shows damage which will be discussed later. The shape of the structure is similar to the German submarine pens so it is

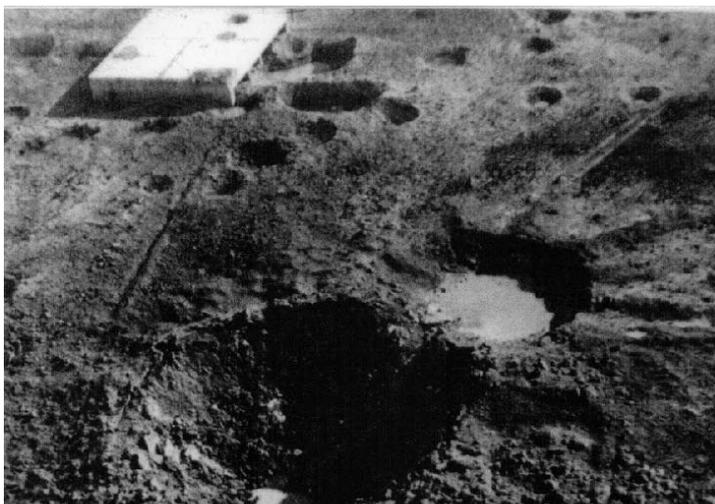


Fig 3 Sub Pens top left in 1945 (crater resulting from testing the Grand Slam bomb in March 1945 middle front)

understandable that this became the colloquial name rather than the wordy 'Ministry of Home Security Target.'

Much has been written about this enigmatic structure since the War. Due to the absence of records concerning the true nature of this building the common perception is that it was built to replicate the German submarine pens built along the Atlantic coast and to test various weapons designed to destroy them.

The 'sub pen' theory is pure conjecture and several factors cause this theory to be challenged. The resemblance of the structure to actual U Boat pens is only superficial. Even the smaller of the German buildings had far more substantial roofs, often with a void between concrete slabs to increase the resistance to bombs.

**Fig 4** shows the U Boat pens at Trondheim. The resemblance to the Ashley Walk structure is apparent but note the massive



Fig 4 Dora sub pens at Trondheim

roof construction. Some of these roofs could be 30 feet thick!

The most significant clue to the purpose of the structure lies in its name – The Ministry of Home Security Target. What was the Ministry of Home Security if in fact it existed? Was it merely a code name such as the Water Carriers for Mesopotamia? The latter was a cover story for the construction in Lincoln of armoured fighting vehicles during the Great War. The workers on these vehicles shortened it to tank!

**Ministry of Home Security:** The Ministry of Home Security was a Government department established in 1939 to direct national civil defence (primarily air-raid defences) during the Second World War. Little had been done to defend against attacks on the civilian population during the First World War, and a need for such measures was seen in the years before 1939, so that plans for the new Ministry were in place when war broke out. Twelve commissioners, acting for the Government, were appointed to manage twelve regions of the UK. Their responsibilities included providing air raid shelters and air-raid wardens (such as ARP Warden Hodges in Dad's Army), gas officers, ambulances and rescue operations. Millions of gas masks were distributed and almost five million people were enrolled as fire-watchers and fire-fighters. The Ministry also had the task of making preparations for the possibility of an invasion, including plans for the British national communications infrastructure being destroyed by enemy action.

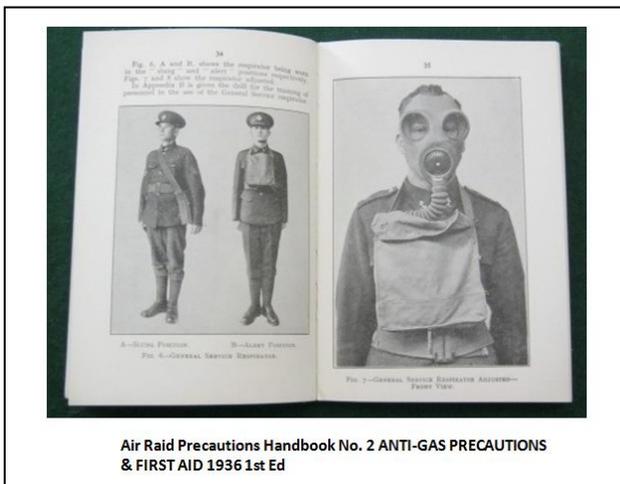


**Fig 5 Bill Pertwee as ARP Warden Hodges in BBCs Dad's Army**

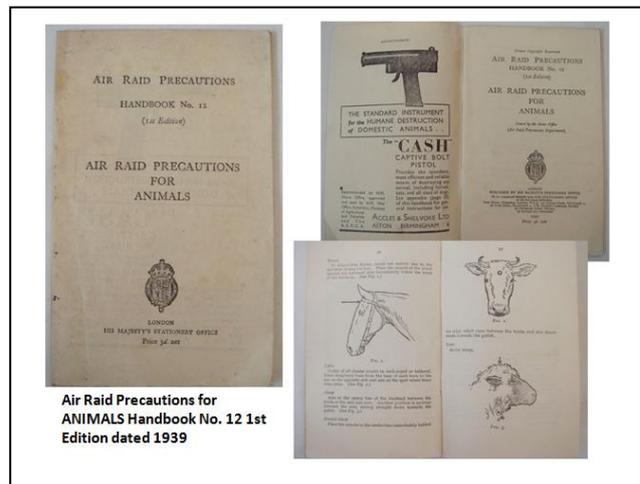
The minister responsible for Home Security at the time of the Ashley Walk trials was the Right Hon Herbert Morrison MP (1940 -1945.) He was preceded by the Right Hon. Sir John Anderson MP (1939 – 1940.) Both these gentlemen will be remembered by the fact that two types of air raid shelters were named after them.

The Ministry produced a series of handbooks setting out procedures and standards to be used in a variety of activities ranging from how to wear a gas mask - ARP Handbook No 2 - to air raid precautions for animals - ARP Handbook No 12 - which appears to concentrate in great detail on the correct procedures for putting down livestock!

Two Air Raid Precaution Handbooks which are relevant to the structure at Ashley Walk are ARP Handbook No 5 – Structural Defence - and ARP Handbook No 5a - Bomb Resistant Shelters - which is an addendum to No 5. Both of these will be discussed later.



Air Raid Precautions Handbook No. 2 ANTI-GAS PRECAUTIONS & FIRST AID 1936 1st Ed



Air Raid Precautions for ANIMALS Handbook No. 12 1st Edition dated 1939

## Ministry of Home Security Target – Ashley Walk:

**Background:** A search of records held by the National Archive using the keywords 'Ministry of Home Security' and 'Ashley Walk' showed several references to a reinforced concrete structure. The documents were obtained from the National Archives and are as follows:

- 1) **Construction of a reinforced concrete structure at Ashley Walk** – the control of concrete quality – carried out by the Department of Scientific and Industrial Research at the Road Research Laboratory on behalf of the Ministry of Home Security January 1942
- 2) **Report on bombing trials on a 6ft thick reinforced concrete target at Ashley Walk** carried out on 12<sup>th</sup>, 13<sup>th</sup> 16<sup>th</sup> and 17<sup>th</sup> May 1943 carried out for the Ministry of Home Security Research and Experiments Department
- 3) **Addendum to 2) above** – report on test by the RAF and USAAF of the dropping of two 4000lb MC bombs adjacent to target July 24<sup>th</sup> 1943

Documents 1) and 2) describe the structure as a full size bomb resistant shelter built by the Ministry of Home Security to test its performance against the results obtained by tests on models at the Road Research Laboratory. The design of the building was based on ARP Handbook 5a- Bomb Resistant Shelters - and modified in light of the model tests.

**Construction:** The work commenced in February 1941 and was completed in September of that year. It was carried out by the Ministry of War Transport on behalf of the Ministry of Home Security.

The materials used were in accordance with ARP Handbook No 5 – Structural Defence. The concrete mix being:

**1 part normal Portland cement, 1 ½ parts sand, 1 part 3/8" gravel, ½ part ¾" gravel, 3 parts 1 ½" gravel.**

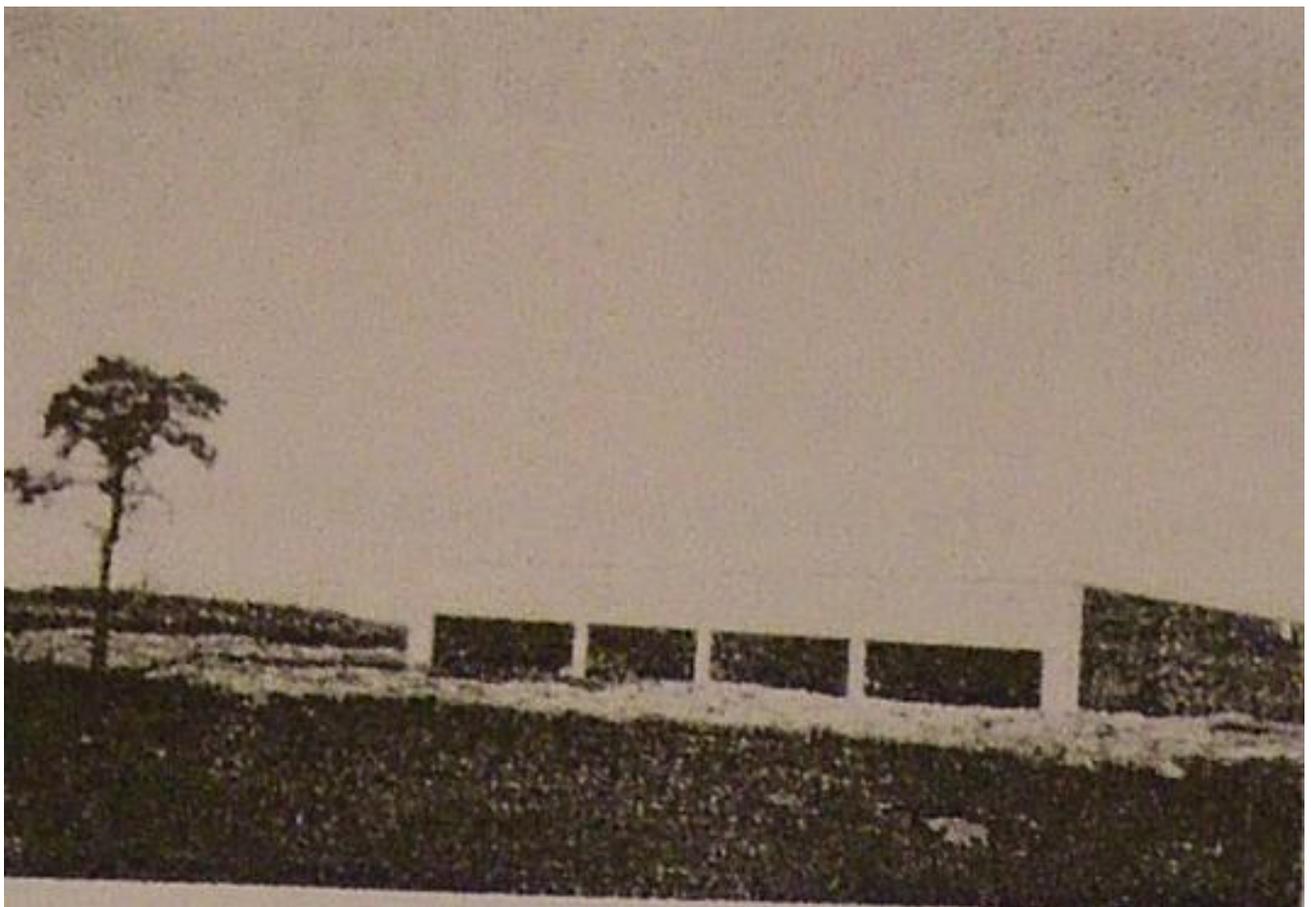
This is very similar to the current recommended proportions as advised by the Concrete Association

**1 part cement, 2 or 3 parts sand, 3 parts gravel, known as the 1:2:3 rule**

The gravel was obtained locally from Messrs Hines Pits at Ringwood and the cement was Blue Circle. A proprietary steel shuttering was used and the walls poured in 4 foot 'lifts' and the roof slab in one 1ft 9in 'lift' and six 8 ½" 'lifts'. All mixing was done on site. The maximum quantity of roof concrete poured in any one day was about 100 cubic yards. The total volume of concrete in the target was 1643 cubic yards using 97200 gallons of water. The total weight of steel used was 121 tons of which 102 tons were reinforcing bars. The remainder was for lining the roof soffits with 3/16" thick steel plates.

Samples were taken from each 'lift' at the time of pour and tested after seven days. **Fig 7** is a plan and elevation of the target showing the positions of each pour and the crushing strength of the concrete after seven days. The average crushing strength was 3450 lbs/sq.in. and at 28 days 4650 lbs/sq.in. rising to 6580 lbs/sq.in after 3 months. The standard at the time as quoted in ARP Handbook No 5 was 3200 lbs/sq.in. after 28 days. These results compare favourably with today's standards and the concrete was of a very high standard

**Fig 6** shows a photograph of the target shortly after its completion and before any tests had taken place



**Fig 6** Target immediately after completion

Fig 7 Plans and Elevations of target showing layers of concrete and test results and the date poured

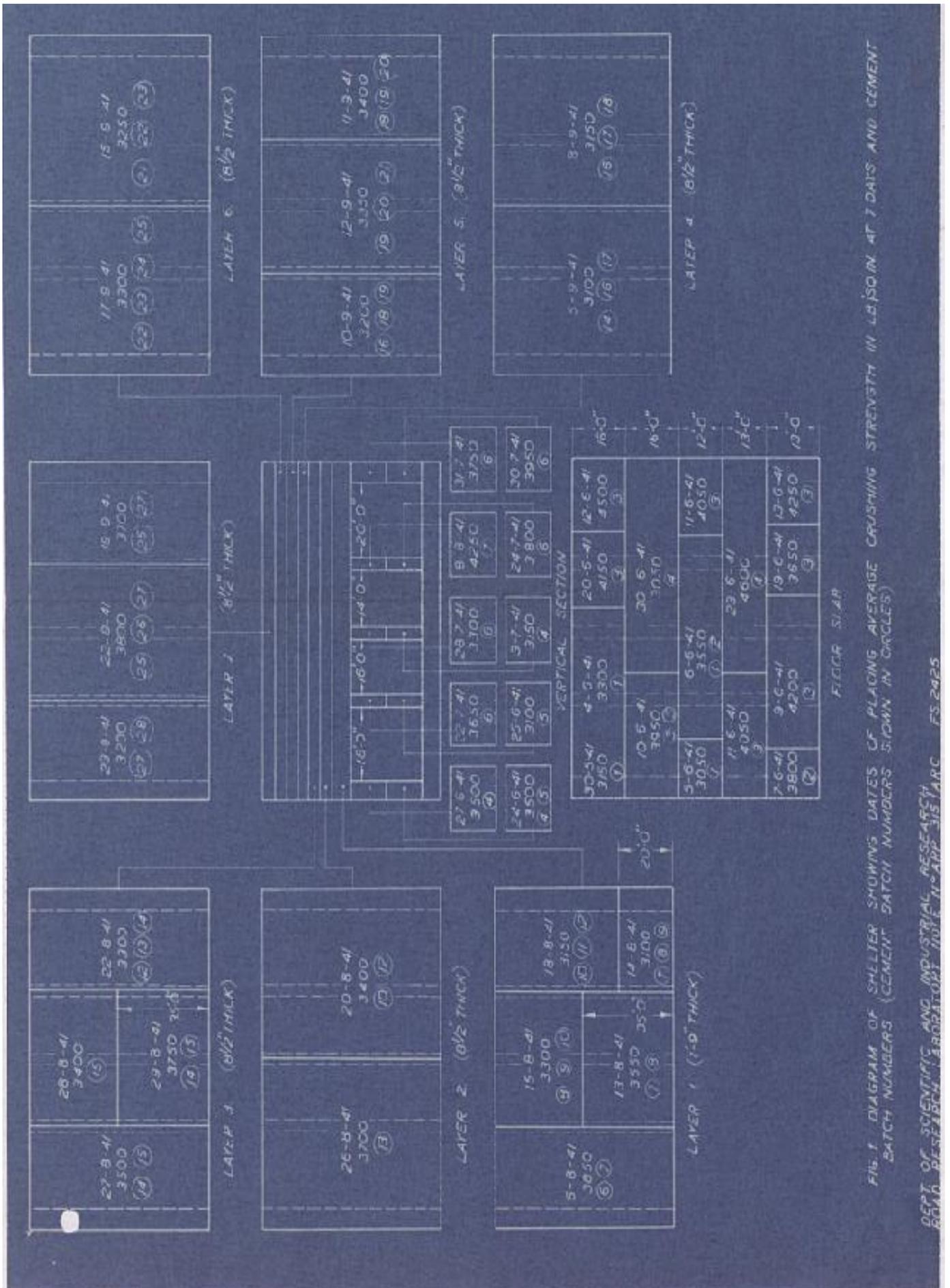


FIG. 1 DIAGRAM OF SHELTER SHOWING DATES OF PLACING AVERAGE CRUSHING STRENGTH IN LB/SQ IN AT 7 DAYS AND CEMENT BATCH NUMBERS (CEMENT BATCH NUMBERS SHOWN IN CIRCLES)

**The Tests:** The following is taken from the report of the trials which took place on the 12<sup>th</sup>, 13<sup>th</sup>, 16<sup>th</sup> and 17<sup>th</sup> May 1943.

Following the completion of the target in September 1941 a number of attempts were made (unsuccessfully) to hit it, but it was not until May 1943. when the formal tests were commenced that a success was achieved by a USAAF Flying Fortress on their 15<sup>th</sup> attempt using a Sperry S1 sight and A5 autopilot, on May 12<sup>th</sup>. They were successful again on the next day with their 9<sup>th</sup> and 13<sup>th</sup> attempts. By arrangement with the RAF, the bombs were dropped from a height of 12000 feet at an air speed of 200 mph. The model tests and

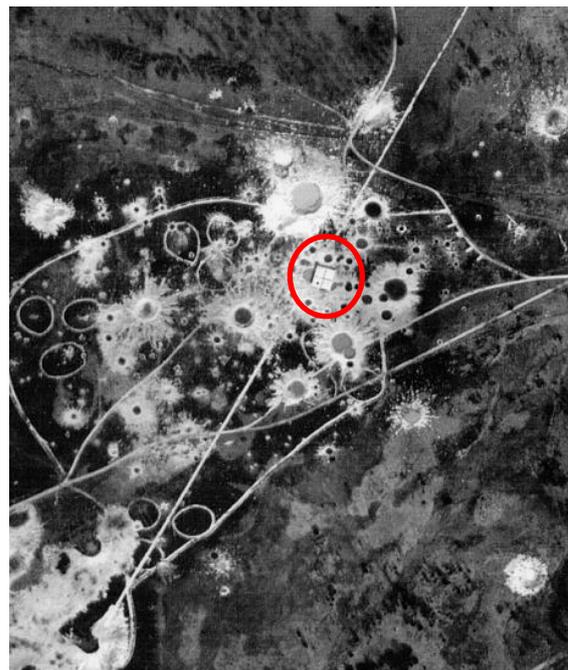


**Boeing B17 Flying Fortress**

calculations shown in ARP Handbook No 5 were based on these speeds and heights. Single bombing runs were made in all cases. The fusing of the live bombs was to be that which in the opinion of the RAF, would ensure that detonation occurred immediately after the bombs came to rest following impact rather than before.

The trials that took place are listed below. As insufficient German bombs were available for the trials and modifications would have been necessary to aircraft bomb release gear, inert equivalent British bombs were dropped to form impact craters. German bombs were to be placed in these craters and fired electrically. It is not known how many attempts were made to achieve the required number of hits of the target but it was probably substantial considering the USAAF Flying Fortress took 28 attempts to achieve 3 hits. **Fig 8** shows the 'sub pens' (circled in red) surrounded by craters in 1947.

The convention is to classify types of High Explosive (HE) bombs by reference to the weight of the container as Heavy, Medium and Light case. Bombs in every category are referred to by gross weight including the fins. Heavy Case (HC) bombs have also been classified as armour-piercing (AP) or semi armour piercing (SAP) and Medium Case (MC) as General Purpose (GP). These definitions are important to understand these tests and more information can be found in ARP Handbook No 5. The typical dimensions of a 500lb GP bomb is five feet long by 15 inches diameter.



**Fig 8**

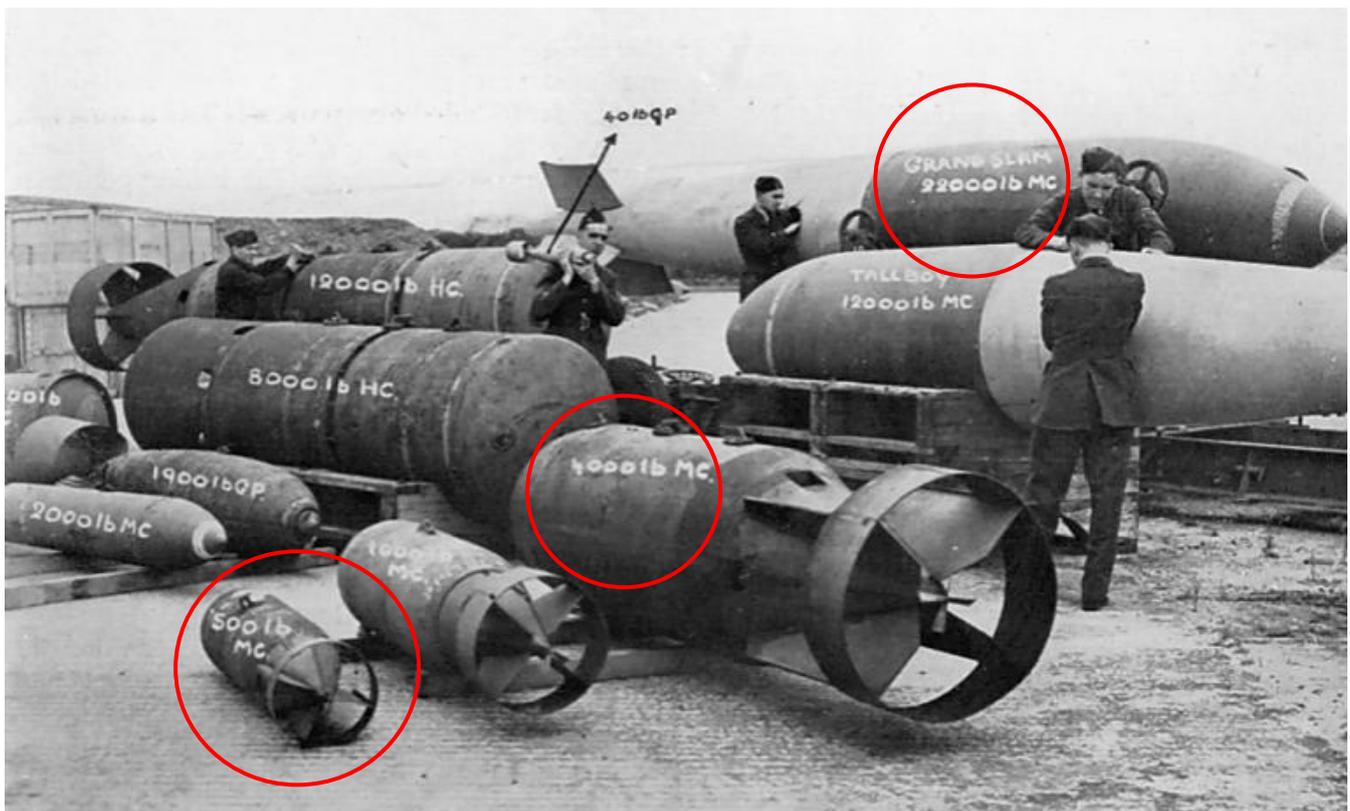


Fig 9 Size comparison of various RAF bombs . The weapons circled in red are discussed in this report

Fig 9 shows a selection of standard British bombs. The 500lb MC bomb is on the bottom left.

### List of Trials

The trials were arranged to determine:

- 1) The combined effect of impact and explosion due to a direct hit by a live British 500lb GP Mark IV bomb dropped from 12000 feet
- 2) The effect of impact only of an inert British 500lb SAP Mark V bomb dropped from 12000 feet
- 3) The effect of the explosion of a German 250kg SC bomb place "nose on" in the crater formed by the 500lb SAP bomb mentioned above. The combined results of 2) and 3) were then compared with that of 1)
- 4) The explosive effect of a German 50kg SC bomb detonated in "side on" contact with one of the 3ft 3in thick side walls of the structure.
- 5) The explosive effect of a German 500kg SC bomb detonated in "side on" contact with the upper surface of the roof slab.

The positions of the hits on the Target are shown on the plan in Fig 10 as Nos 1, 2 and 3. The static bombs were detonated electrically at the positions marked Nos 4, 5 and 6

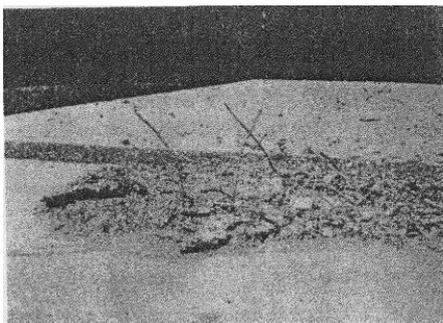


## Results of the Trials

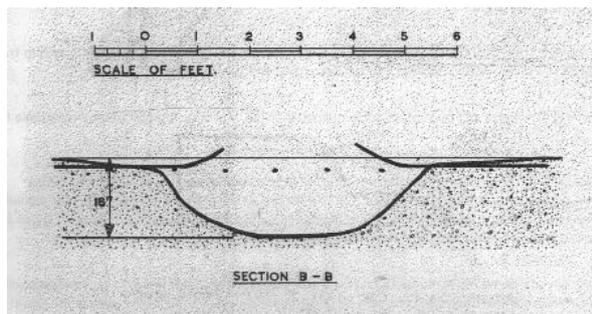
The results are a summary from the Ministry of Home Security Report RC392. For full details including comparison with the model tests, the full report should be read in conjunction with the empirical formulas and theoretical calculations shown in ARP Handbook No 5.

### Bombs released from aircraft

**Bomb No 1:** This was a British 500lb GP Mk IV bomb filled with TNT and fused 1/10<sup>th</sup> sec nose and 1/40<sup>th</sup> tail dropped from 12000 feet at an air speed of 200 mph. The bomb hit the target at about 18 feet from the unsupported west edge of the roof slab and approximately at the centre of the span of the 14 foot bay



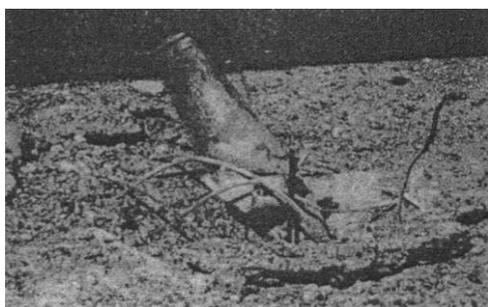
**Fig 11: Bomb Crater showing reinforcing bars bent up**



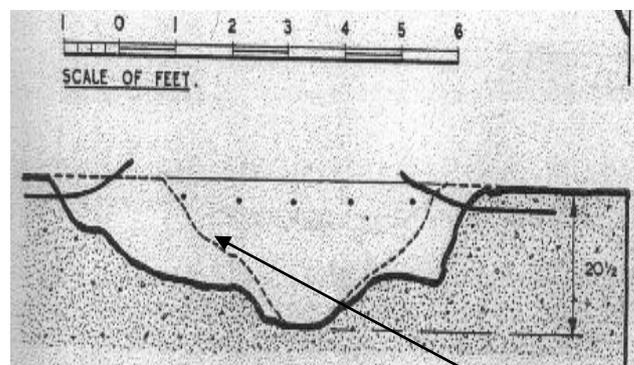
**Fig 12: Section through the crater.**

The maximum depth of the crater was 18 inches. The bottom was flat suggesting the bomb stripped the concrete at a construction joint. Gauges within the shelter showed an elastic deflection of  $\frac{3}{4}$ " but no distortion of the soffit plates.

**Bomb No 2:** This was a British 500lb SAP Mk V bomb filled with a suitable high explosive substitute by the Royal Ordnance Factory Woolwich. It was dropped from 12000 feet at an air speed of 200 mph. It hit the target at about 15 feet from the west edge and 6 feet from the north edge of the roof slab. The point of impact was within the clear span of the 20 foot bay at about 2ft 9in from the inner face of the 3ft 3in thick supporting wall. The bomb showed no outward sign of damage.



**Fig 13: Bomb still in position after impact**



**Fig 14: Section through the impact crater, The dotted line is the crater formed by the impact of the inert bomb. There was no apparent damage to the underside of the slab and no deflection measured**

**Bomb No 3:** This was similar to bomb No 2 being an inert 500lb British SAP Mk V bomb. It hit the north west corner of the target over the 3ft 3in thick supporting wall and broke away



the concrete down to the level of the intermediate layer of slab reinforcement 2ft 6in below the top surface. The bomb bounced off and buried itself in the earth. At the time of the report it had not been recovered and may still be there!

This test was of no particular value to the test programme, but it was intended that the measurements obtained could be used to calibrate future model tests. It was not included in the list of trials

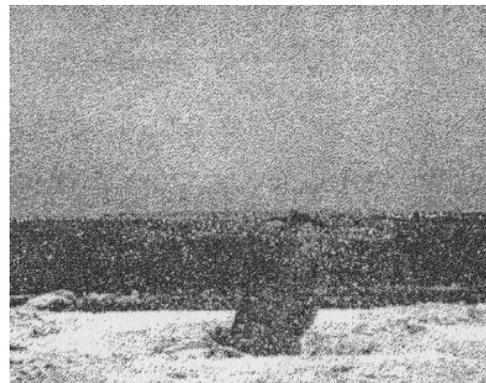
**Fig 15 Damage to corner of target caused by Bomb No 3**

### **Bombs detonated statically**

**Bomb No 4:** A German 250kg SC bomb was placed on its nose in the crater formed by bomb No 2. The German bomb was almost identical to the 500lb British bomb although had a slightly heavier charge weight (285lb versus 250lb). Insufficient German bombs were available for actual dropping trials. The bomb was detonated electrically and the crater formed was almost double the size of the crater produced by the inert bomb No 2 but the maximum depth remained unaltered – See **Fig 14**. Some damage was caused by the soffit deflecting. The deflection was beyond the maximum 1 inch measurable by the gauge. The damage caused was greater than the theoretical calculations indicated

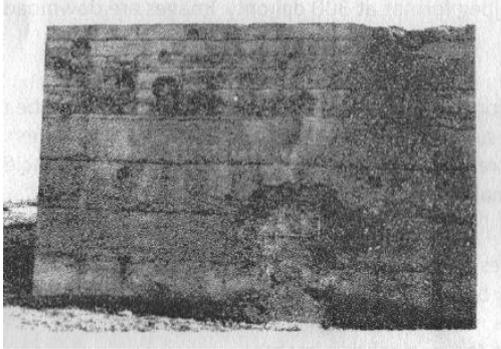


**Fig 17 Crater formed after detonation**

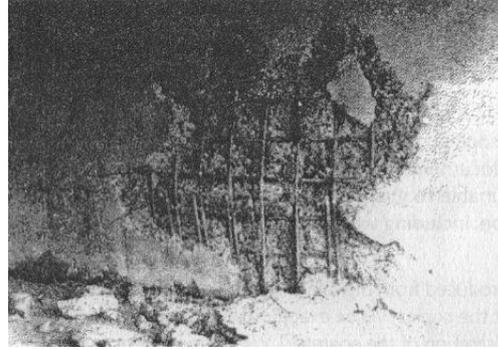


**Fig 16 Bomb in position before detonation**

**Bomb No 5:** This was a 50kg (57.2lb charge weight) German bomb placed in a vertical position on the ground with its side in contact with a 3ft 3in thick outside wall. The bomb was detonated electrically. The crater was approximately 4 feet in diameter with a maximum depth of 9 inches. No reinforcing bars were severed. The observed damage was slightly less than expected. However the spall damage to the internal wall was greater than expected. The maximum spall area was 9 feet by 6 feet with the largest scab being 9in x 12in x 4in.

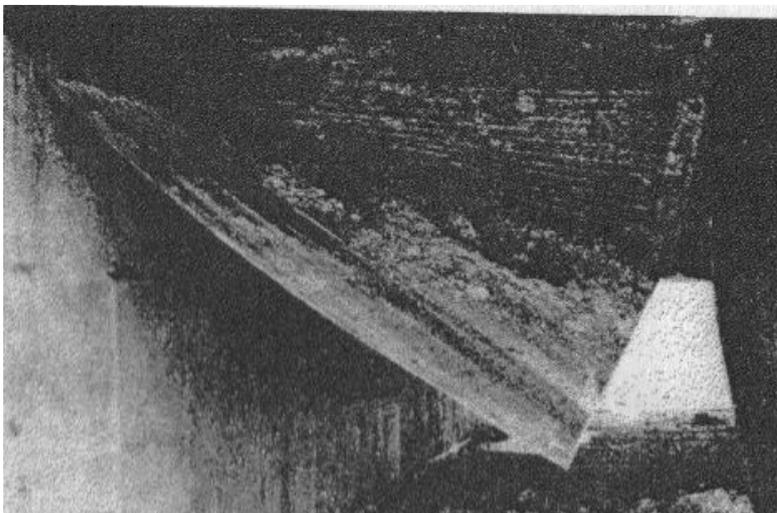


**Fig 18 Bomb crater**



**Fig 19 Spalling of internal wall**

**Bomb No 6:** This test was to ascertain the resistance of the target to the maximum explosive effect of a larger bomb than the British 500lb GP for which the roof was designed. A German 500kg SC bomb was placed on its side on an undamaged part of the roof slab at the centre of the 18 foot span and 20 feet from the unsupported west edge and detonated electrically. Theoretical calculations indicated that the roof would not be perforated as the slab was 9 inches thicker than calculated for this size of bomb. Perforation did not occur as although the concrete shattered throughout the thickness of the slab, it was held in place by the tension of the reinforcement. The maximum permanent deflection was 31 inches at the centre of the 18 foot clear span of the bay. The crater in the top surface was 11 feet mean diameter and 2 feet 1 inch deep nominally.



**Fig 20 showing internal damage to target. Note the bulge and damaged steel soffit sheet**

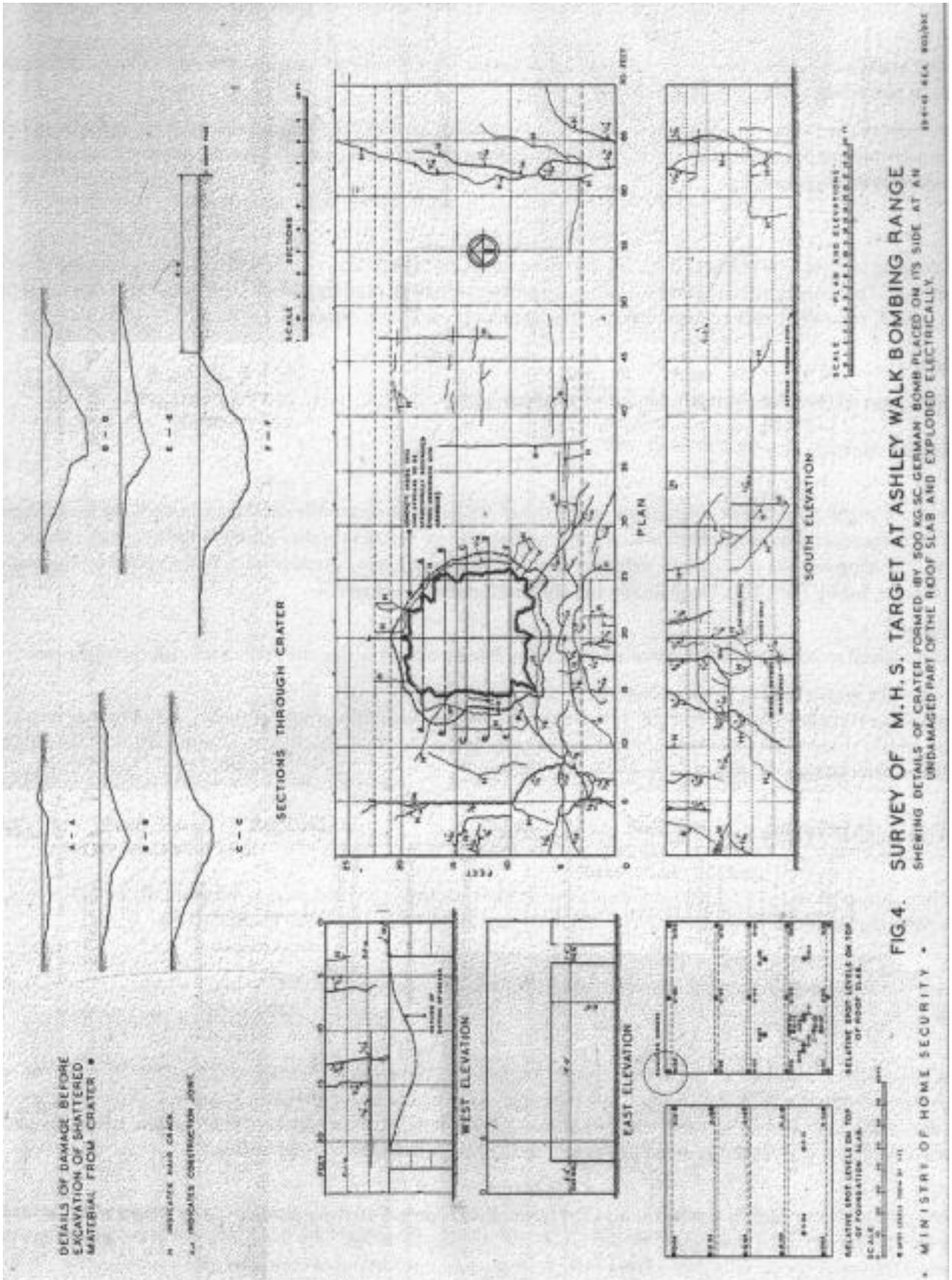


Fig 21 Plans and elevations showing extent of damage caused to the target by Bomb No 6 German 500kg SC bomb

## General Summary of the Trials

The recommendation was that further model tests should be carried out to compare tests with the actual results. However the following suggestions were made.

- 1) It was considered sound practice to concentrate the bulk of the steel reinforcement near the inner face
- 2) Some steel was required in the body of the slab (roof) to reduce extensive cracking (Bomb No 6 – see **Fig 21**)
- 3) The 'cover' of the inner face should be kept small – less than 1 inch (Bomb No 5)
- 4) Steel plate lining the inner face should not be confined to the soffit but should be extended to all the walls and be well anchored.
- 5) It is probable that an improved design would be to form the soffit of the slab on steel troughing. It would be advantageous to form the walls in a similar manner thus forming a complete portal. In this way the bulk of the steel would be concentrated on the inner surfaces and the outer concrete cover would only need to be lightly reinforced. Such a scheme, which was considered as an alternative when the target was built, would seem to have advantages from two points of view. Efficiency and economy.

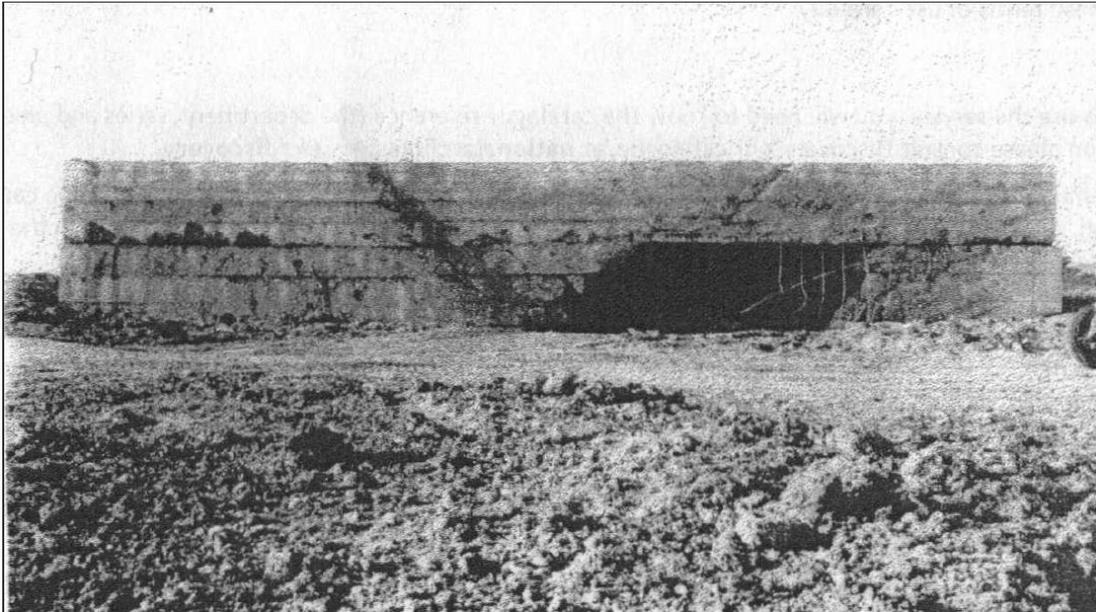
Whether any further model tests were carried out is not known.

Subsequent to the formal trials as described the target was placed at the disposal of the RAF and the USAAF. On July 24<sup>th</sup> 1943 two 4000lb MC (charge weight 2200lbs) bombs were dropped very near the target. Note the suffix is MC (medium capacity). The HC (high capacity) bomb had come into service in 1941 when 531 were dropped with the number rising to 25476 during 1943 alone! They were the first of the Blockbuster Bombs designed to blow all the roofs off a city block allowing incendiary bombs to penetrate the building shells. They were huge bombs being nearly 8 feet long and 2 ½ feet diameter. They were completely cylindrical with no guidance fins or nose cones so were not capable of being used with pinpoint accuracy and were therefore rather indiscriminate.

There was a need for a 4000lb bomb that could be dropped with accuracy and the 4000lb MC bomb was developed from the HC version. The design brief was that the bomb should be capable of being dropped from low heights and withstand impact against metalled roads and concrete structures – in fact these were to be early 'bunker busters.' The tests at Ashley Walk are the first known live tests of these bombs (See **Fig 9** for a photograph of this type of bomb.)

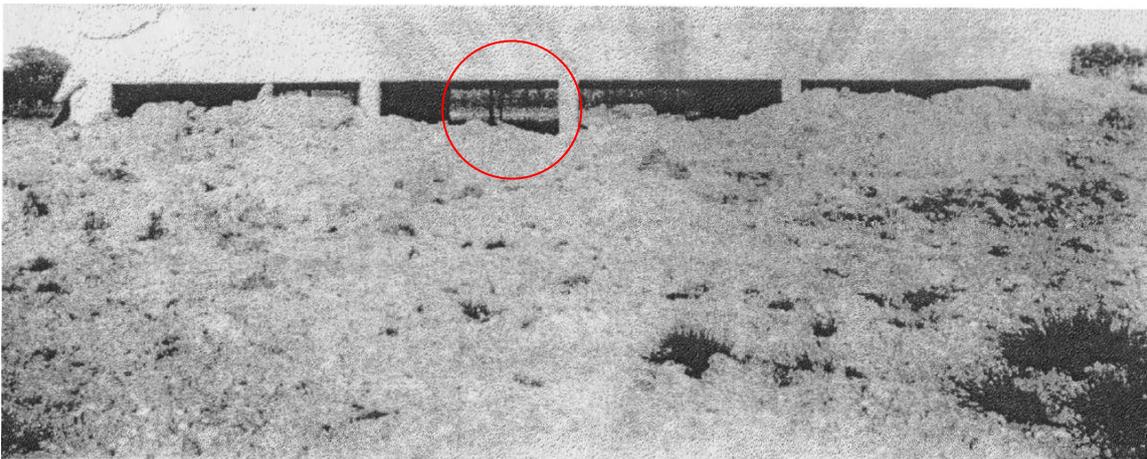
The first bomb (Bomb No 7) was dropped from 5000 feet and struck the ground very close to the south side of the target probably within 2 feet from the 3 foot 3 inch supporting wall. The crater was estimated to be 36 feet diameter by 10 feet deep. It is thought that the bomb detonated when its nose was about 5 feet below ground level. The south wall of the target was demolished up to soffit level for a length of 24 feet. The ends of the standing portions of this wall were moved. There was considerable cracking to the roof.

The floor damage could not be assessed due to the amount of debris from the roof slab



**Fig 22 Damage to target after Bomb No 7 4000lb MC exploded on the ground nearby**

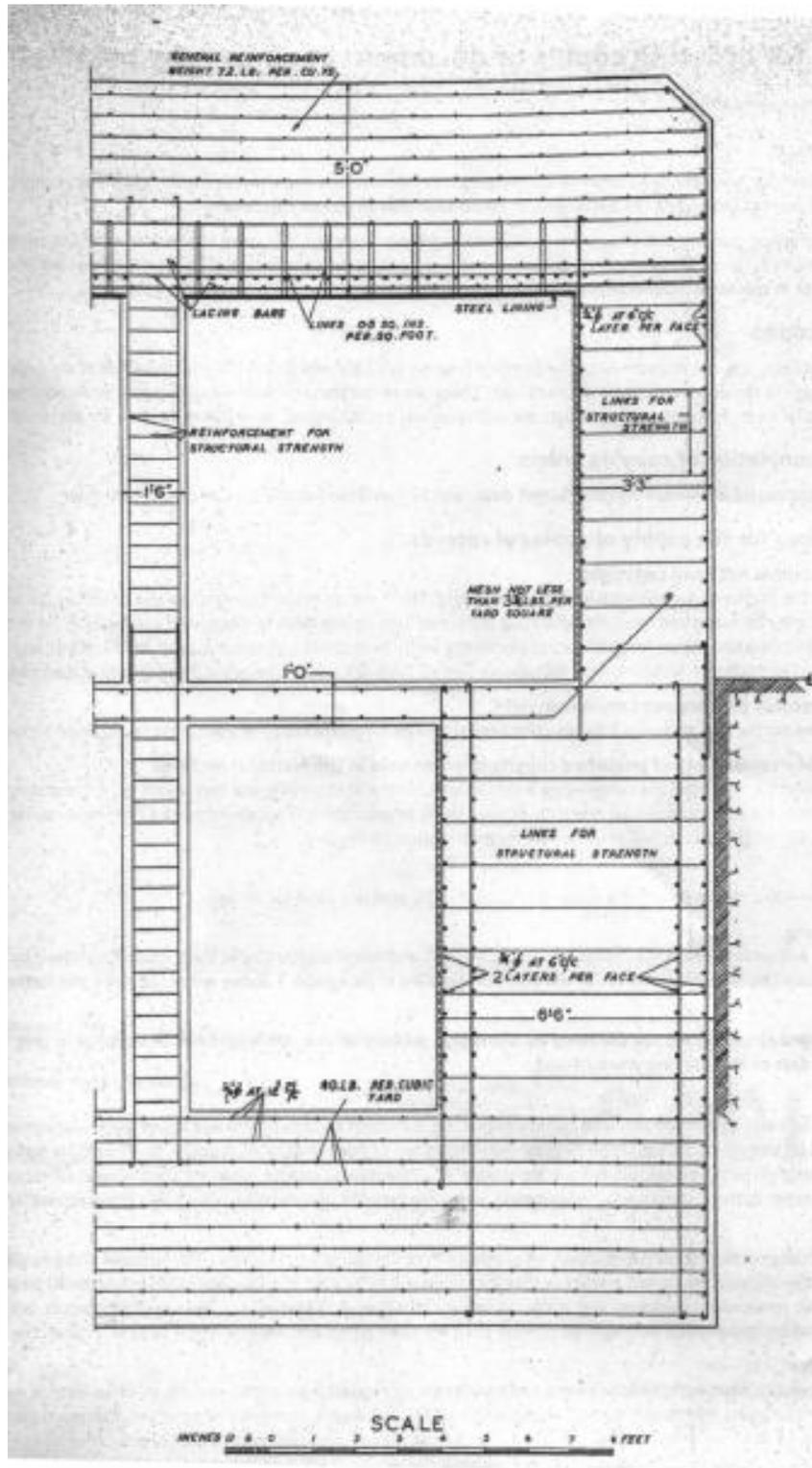
The second bomb (Bomb No 8) was also dropped from 5000 feet and was estimated to have struck the ground about 9 feet from the west side of the target. The crater dimensions were reported as 54 feet diameter and 14 feet deep. The conclusion was that it detonated when its nose was about 10 feet below the surface. The main effect of this bomb was to the floor of the target. In all bays the floor was bowed up at the end nearest the bomb. The maximum being 2 feet 9 inches in the 16 foot bay. A small part of the floor was demolished in this bay.



**Fig 23 Bomb No 8 exploded in the ground about 9 feet from the target. Note the props supporting the roof in bay 2**

It is estimated following these tests that the wall thickness would need to have been increased to 11 feet to avoid this damage and at least to 9 feet to avoid penetration.

No further tests are known to have taken place although the 10 ton Grand Slam Bomb was dropped near the target in March 1945. This huge bomb is also shown in **Fig 9**.



**Fig 24 Reinforcement Detail**

As mentioned earlier the target was built in accordance with the design criteria of Air Raid Precautions Handbook No 5a – Bomb Resistant Shelters - and to give protection classified as Type 3. That is to give adequate protection against 500lb MC bombs striking at maximum velocity. It is interesting to note that the standard construction shown in ARP Handbook 5a has two floors – a ground floor and a basement. It would only have been necessary to construct the above ground part at Ashley Walk as this was the section which was under test.

**Fig 24** to the left is a cross section through a shelter showing both floors. The details are the same as Ashley Walk except that the roof slab is only 5 feet thick instead of 6 feet **Fig 25** on the next page shows plans and elevations for a typical two level shelter for 200 people. Note the airlock and external steps

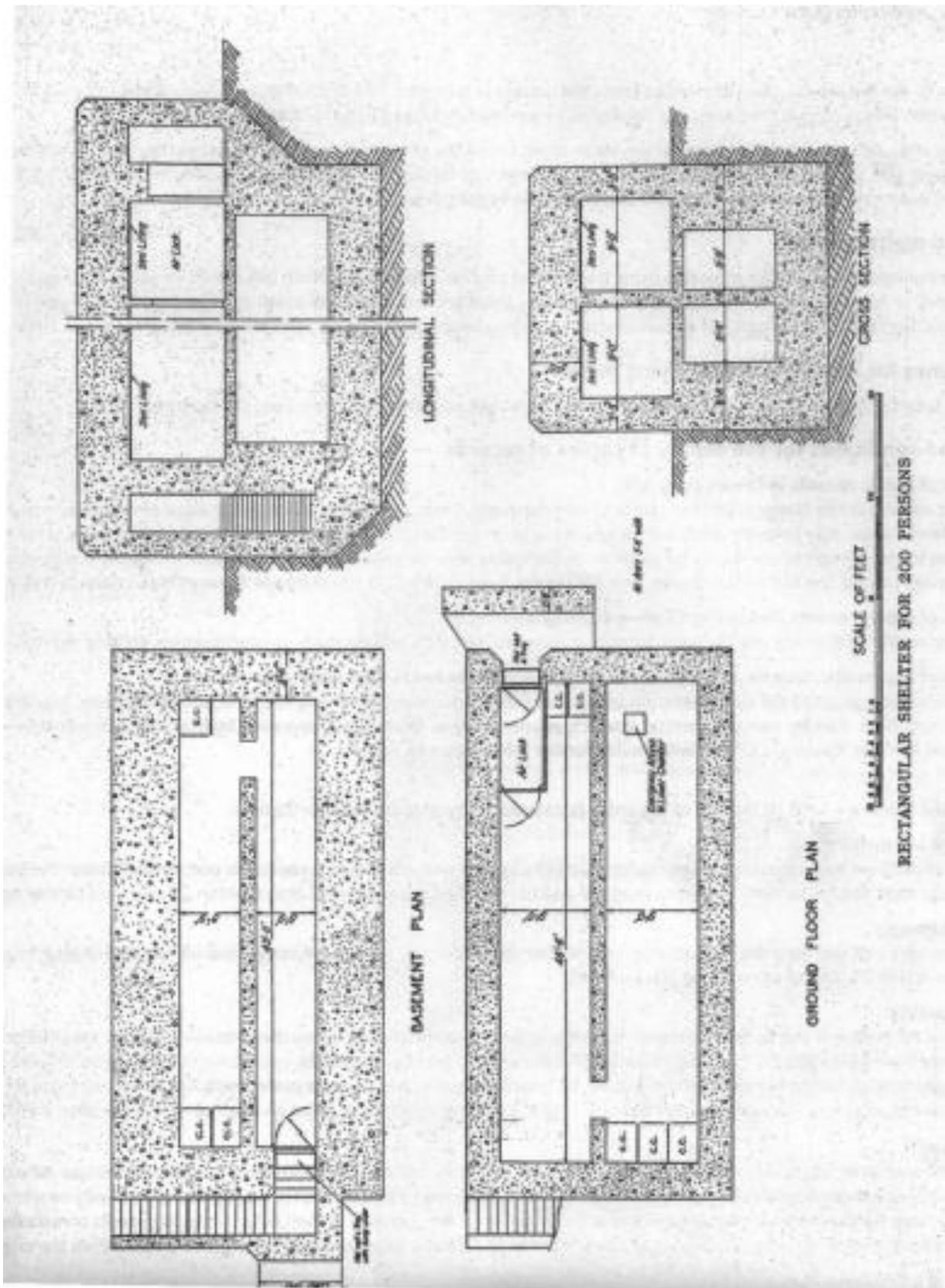
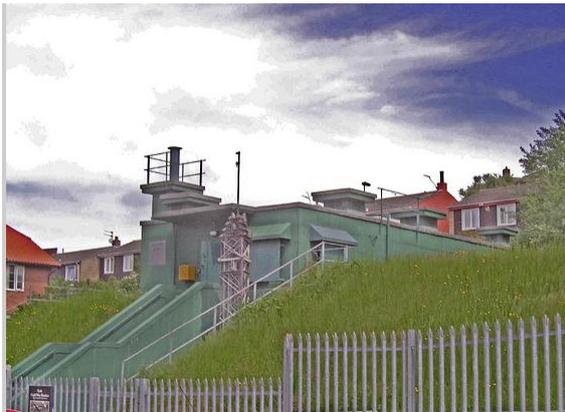


Fig 25 Two level shelter as specified in ARP Handbook No 5. Ashley Walk target was based on the above ground level

As can be seen from the foregoing, the target at Ashley Walk was the above ground section of a two level bomb resistant shelter based on the Ministry of Home Security specifications. It was designed to withstand a direct hit from a 500lb medium capacity bomb. In this it was proved successful and the results came very close to those calculated from the model tests.

However, it proved incapable of withstanding the large 4000lb MC bombs which were dropped towards the end of July 1943 and was severely damaged, The purpose of the July test is currently unknown. As these bombs were virtually untested at that time it is likely that it was a test prior to raid on a large concrete structure. Perhaps this was against a

German Submarine Pen, only further research will uncover the facts.



**Fig 26 ROC Group HQ 20 Group York**

No further formal tests are known to have been carried out after 1943 and at the end of the war the target was covered in earth and now resembles a tumulus. Time and weather has started to erode the ground cover and some of the concrete is appearing. There is no knowledge of any programme to build these huge civilian air raid shelters and by the time the Ashley Walk trials were completed, the tide of the

War had turned and the threats to the UK civilian population from air attack was reducing. However the legacy of these tests may have passed on to the Cold War period. This two level bomb resistant building will be familiar to those who served in United Kingdom Warning and Monitoring Organisation and Royal Observer Corps during this time as it very similar in design to the 'semi sunk' ROC purpose built Group Headquarters such as the one in York.

**Henry Cole January 2013**

**References:**

**Ashley Walk, Its Bombing Range, Landscape and History** - Anthony Pasmore and Norman Parker (The New Forest Research and Publications Trust 2006)

**Air Raid Precautions Hand Books No 5** - HMSO First Edition 1939

**Air Raid Precautions Hand Books No 5A** - HMSO First Edition 1936

**Construction of a reinforced concrete structure at Ashley Walk 1943** –National Archives  
**Report on bombing trials on a 6ft thick reinforced concrete target at Ashley Walk 1943** – National Archives

