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REPORT OF A MEETING CONCERNING B-52 HARDENING

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On October 8, 1959, Alain Enthoven and the author attended an AFOCE meeting at the Pentagon. The purpose of this meeting was to bring together a group familiar with shelter design to provide them with a background of data which would be useful, if and when, a prototype B-52 shelter is built. A list of attendees is included at the end of this document.

General Kelley (AFOCE) called the meeting to order and then turned it over to Colonels Lowry (AFOCE) and Impson (AFOCE-E). Colonel Impson acted as chairman and stated that the meeting should cover the following topics:

- o Formation of a B-52 hardening panel
- o Construction of a prototype B-52 shelter in order to verify costs and to help in "getting some action from SAC"

In addition, several members of the audience were asked to give presentations concerning their respective fields of endeavor in order to develop a round-table discussion. The presentations were as follows:

Colonel Lowry discussed the B-52 aspects, viz., B-52H does not have a folding tail. The kill requirement for a weapon yield of 5 MT and 2-1/2 n mi CEP and 200 psi overpressure are:

75 per cent kill - 34 missiles

90 per cent kill - 56 missiles

The curve flattens at about 100 psi and the separation distance is about 12,000 ft.

An austere base would be designed with the following ground rules:

Minimum command post - 1/base, 25 men

Minimum personnel facilities - 15 men/aircraft

RATO storage - 70 bottles/aircraft

Debris removal and recovery equipment must be provided

Five-minute door opening time

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Alain Enthoven stated the RAND position on B-52 hardening. He recommended 200 psi hardness (or even greater). He also briefly mentioned work performed at RAND on fallout, debris clearance, and in-shelter B-52 maintenance.

Sandoval reviewed RAND work on shelters and quoted shelter cost estimates prepared by both RAND and ARDI. A model of William Burk's composite planform shelter for the B-52 (folding tail) was demonstrated, and a discussion of elevator costs ensued. Several members, influenced by estimates from Westinghouse, thought that the elevator would cost in excess of \$600,000. However, Ed Cohen and Paul Weidlinger both stated that Westinghouse was not a proper source for cost estimates on this type of elevator. Jacob Feld also mentioned that he had designed an elevator of similar capacity at a lower cost.

Paul Weidlinger discussed the "state of the art." He concluded that, except for ground shock, we have advanced to such a point that we can design 200 psi shelters with confidence. He also pointed out that sealing of the doors and locking against rebound are problems that require further investigation.

Captain Traylor (Hq AFSWC) discussed the state of art from the basic research viewpoint. He was quite pessimistic. He stated that our knowledge of soils response is confused, limited to test site conditions--that we actually "know nothing." He said that we don't know how to build underground (or sub-surface) shelters because of the lack of data and that we shouldn't "go off half-cocked."

He gave a brief description of the planform, arch, and dome shelters. He is particularly interested in the aboveground dome because there are less

unknowns (?). He described the pumpkin-slice door, Fig. 1.

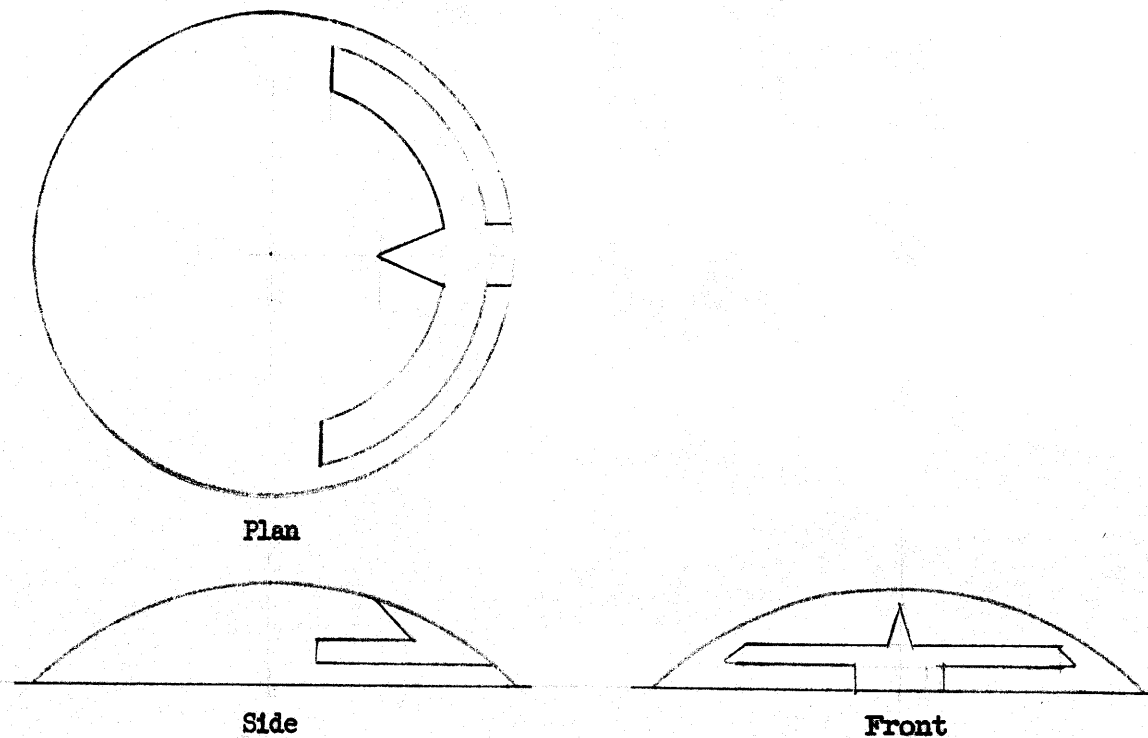


Fig. 1

The door is shaped to clear the wings and vertical tail of the aircraft. In opening, the door is lifted vertically, then rotated to one side on a rail. Tensile forces at the interface are carried by a zipper-type mechanism which is still being studied. Shear forces are taken by friction of the bearing surfaces. His group at AFSWC is presently making a study of stress concentration under dynamic loads at the interface.

David Singer (ARF) gave a brief discussion on the feasibility and necessity of hardening in general. He stated that our weapons systems should be designed for deterrence rather than retaliation. Most of his talk had little to do with B-52 hardening. Without any introduction, he presented the results of a comparative cost study prepared by his group. The data are shown in Table 1. The costs shown in Table 1 are for the raw structure

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and are based on the usable area. Structural members were designed to resist a static load equal to the overpressure. In some cases, however, radiation rather than blast pressure was the governing factor. Ground shock was neglected because he "guesses" that it is not critical for personnel.

Table 1

Structure	Overpressure (psi)	Cost \$/sq ft (in clay)	Burial depth (ft)	Cost \$/sq ft (in sand)	Burial depth	Cost of surface structure \$/sq ft
10x10x10 cube	25					29
	100					110
	1000					
10x10x10 cube	25	24	0	23	0	
	100	50	5	35	0	
	1000	246	25	64	12	
100x100x10' high 100-ft spans	1000			220	115	
	1000			190	105	

His presentation was rather disjointed, and it appeared that he was unprepared.

Lieutenant Colonel Stone (DSM, ARDC) had little to report. He merely stated that AMF is conducting a study effort for Detachment No. 1, Hq ARDC, titled "Site Hardening Study for an Aerodynamic System," Project 7931.

Thomas Morrison (AMF) described the dome shelter. He believes the dome shelter to be superior if they can come up with a magic door (his words) to provide entrance and exit. He had no cost figures for the dome, but stated that an arch-type structure with a 12-ft thick concrete shell could be built for about \$3 million per aircraft.

The subject of the B-52 hardening panel was not pursued.

The following day, Alain Enthoven and the author had a private discussion with Colonel Impson. He reiterated that the purpose of the meeting was

to bring together a group of people, in the know, that could provide them with some background that would be useful if and when they built a prototype. He also stated that it would not be necessary to harden POL since the aircraft could be fueled prior to sheltering and that RATO was being programed into the system. He felt that the purpose of the meeting had been accomplished and indicated the probability of a follow-up meeting.

List of Attendees

H. K. Kelley	Brig General	AFOCE
Ivan H. Impson	Colonel	AFOCE-E
Paul W. Stephens	Colonel	AFOCE-EA
M. E. Jewell	Colonel	AFOCE-EE
T. J. Lowry	Lt Colonel	AFOCE-ES
Harvey Lynn	Civilian	The RAND Corporation
Paul Weidlinger	Civilian	The RAND Corporation
Charles Sandoval	Civilian	The RAND Corporation
Alain Enthoven	Civilian	The RAND Corporation
E. Cohen	Civilian	Ammann & Whitney
D. B. Singer	Civilian	Armour Research
Gilbert Rocan	Civilian	American Machine & Foundry Co.
Don Arenson	Civilian	American Machine & Foundry Co.
T. G. Morrison	Civilian	American Machine & Foundry Co.
S. H. Lowry	Lt Colonel	Hq ARDC - RDSIW
W. D. Neill	Lt Colonel	AFOCE-EA
J. S. Stone	Lt Colonel	DSM, ARDC
Norman F. Schrein	Civilian	Detachment No. 1, ARDC
Jacob Feld	Civilian	Consultant
A. L. Westrich	Civilian	AFOCE-EE
J. H. White	Civilian	AFOCE-ES
C. M. Whitehead	Major	AFOCE-ES
J. Fullilove, Jr.	Major	AFOCE-CS
M. E. Traylor	Captain	Hq AFSWC
Theodore Bacha	Captain	AFOCE-ES
A. R. Deptula	Captain	AFDRD-GW
Norval Dobbs	Civilian	Ammann & Whitney