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U. S. STRATEGIC BOMBING SURVEY

APO 234, c/o Postmaster
San Francisco, California

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Capt.Elliott

TARGET 90.25-1547
Kawasaki Aircraft Co
at Akashi
PRELIMINARY DRAFT

1. Location and Official Personnel

Target 90.25-1547 lies about two miles west of the town of Akashi and consisted of the Akashi engine plant(Akashi Hatsudaki Kajo)and the Akashi fuselage plant(Akashi Kitai Kojo). Both of these plants belonged to the Kawasaki Aircraft Co. (Kabushiki Kaisha). The Akashi aircraft plant was moved from Kobe to Akashi in September 1940,while the fuselage plant was moved from Gifie City to Akashi in November. Both plants were in production by the end of the year and are hereafter called the plant.

Mr.Shujira Ito was Technical Director of the Kawasaki Aircraft Co. and held the rank of Lt.General at the time of his retirement from the Japanese Army in 1937. Mr Komoda was the Architectural Engineer for the firm. The latter, a graduate of Tokyo University, travelled in the States for several months during the year 1929. All engineering data on buildings, such as, Live Loads,Wind Loads,Floor Loads,etc,were furnished by Mr.Komoda.

2. Capital

The Kawasaki Aircraft Co., a joint stock company with a nominal capital of 300 million yen has a paid up capital of 150 million yen,based on a prewar value of 4.2 yen to the dollar. The company was incorporated in 1937.

3 Products

This company manufactured airplane engines and fuselages. The total output of all the company's plants including this target(1547),represented 25% of all engines used in Japanese planes. The highest monthly production of engines was 480 in October 1944, See Table "A" page_____.The last month before our raids started,Dec.1944,410 engines and 50 fuselages were built,see Table "B" page_____.

Two types of fuselages were manufactured Ki-45,a two seater fighter and Ki-102,a night fighter. The engines used in these two types of fighter planes came from Mitsubishi Jukagy in Nagaya. For production figures for 1944 see Table "B" page_____. For production figures for both engines and fuselage for January to August 1945 see Table "C",page_____

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Table "A"

Engine Production Oct.1944

Type	Number	Type plane in which used
HA-115	210	(a)Ki-48 Light Bomber (b) Nakajima Fighter
HA-40	200	Ki-61 Fighter
HA-140	70	Ki-61 Modified fighter
TOTAL	480	

Table "B"

Fuselage Production 1944(both types)

Jan.	Feb.	March	April	May	June	July	Aug	Sept.	Oct	Nov.	Dec.
76	78	86	88	62	70	111	119	109	97	51	50*

*50 composed of 14 Ki-45 and 36 Ki-102

Table "C"

Production for 1945

	Jan	Feb	March	April	May	June	July	August.
Engine Assembly & for Tests	158	69	50	292	285	195	128*	None
Fuselage	14	34	24	44	18	18	14	None

* Note;An idea of the function of the Akashi plant may be gained from the following figures for July 1945(a) Two thirds of the 128 engines were air cooled and assembled at the Futami plant of the Kawasaki Aircraft Co. The engines were only tested at Akashi.(b)One third of the 128 engines turned out at the Akashi plant were water cooled. Sixty percent of the assembly work on these engines was done at the Takatsuki plant of the Kawasaki Aircraft Co. and only the final 40% of the assembly work and the testing was done at Akashi.

4. Financial Loss

Buildings	43,268,000
Machinery,tools etc.	9,904,000
Stock	9,847,000
Semi-finished products	62,895,000
Miscellaneous	4,148,000
TOTAL	130,062,000 yen

The above total was recognized by the insurance company and paid.

Financial Loss for June and July Raids

The aggregate loss for the four H.E.raids was 70 million yen. This sum was presented to the insurance companies but had not been paid as of 10 Nov.1945

Total Loss to the Kawasaki Aircraft Co

The total loss to this company as a result of the raids on its plants and establishments in nine cities was estimated at 415,309,000 yen.

Attached.

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5. Employees;
Just prior to the raid of 19 Jan.1945,about 25,000 workers were employed at this plant. Following this raid the workers were gradually dispersed and at the time of the 22 June raid only 15,000 workers remained.

6. Dispersal of Tools and Parts
As of 1 Jan.1945 the number of machines(presses,machines tools etc.) at target was 2171. By 22 June only 324 machines,tools etc.were left at the plant,of which number 228 which were mostly tools in the engine plant and 96 mostly presses in the fuselage plant.

Table "D"

Dispersal of Tools and Parts FebthruApril 1945

Month	Tools & Parts	Moved to	Number Moved
Feb.	Lead & Bronze Parts	Sakai	Not known
	" " "	Nisshen Aircraft Metal Co in Kobe	13
	Main connecting engine rods	Osaka Seisa Co.at Fuku (near Osaka)	144
	Rocker arms	Hoto Branch	Not known
	Case-hardened small parts	Hokuban Branch	Not known
	Pistons	Showa Seiki Co.	20
Feb. to Apr.	Crank shafts,rods & cam shafts of liquid cooled engines	Ibaragi Plant of Osaka Seisa Co.	194
Mar.	Cutters	Otsu Branch	90
	Inlet Valves	Yashima Valve Co.	45
Apl.	Trial parts,jigs and fixtures	Nishinomiya Branch	222
	Jigs and fixtures	Yashiro Branch	141

7 Air Raids reported 1945

19 Jan.	H.E. raid	7 July	1.B. raid
22 June	" "	28 "	H.E. "
26 "	" "	30 "	" "

8. Unexploded bombs
19 Jan raid,30 required three weeks to explode these
22 and 26 June raid -none
28 July raid,only 4 dropped of which 2 did not explode
30 July raid,-none

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9. Number dead and injured in Raids

Date	Dead	Injured	Date	Dead	Injured
19 Jan	268	99	7 July	None	1
22 June	5	7	28 "	"	None
26 June	5	19	30 "	"	"

10. Analysis of Physical Damage to Target 1547

First will be damage data submitted by the Kawasaki Aircraft Co.For financial loss see Page_____. Secondly the physical damage as gathered by Field Team No.3 of the survey with drawings,sections and comments. Estimated damage to buildings and Engines and Fuselages within the plant at the time of the raids are noted below.

Check

Table "E"

Estimated Damage to Bldgs ~~etc.~~

Raids	Damage %	Possible Repair	Actual Repair
19 Jan	40	30%	15 %
22 June	15	7	None
26 "	10	5	"
28 July	Slight	2	"
30 "	"	1	"
	8		8

General

Table "F"

Misc.Damage to Engines and Fuselages within Plant

Raids	Engines in plant	Damaged %	Fuselages in plant	Damaged %
19 Jan	1509	15	662	14
22 &26 of June	96	50	228	50

11. Design stresses and loads

It might be of interest here to note the design stresses and loads used on buildings in this plant as given by Mr. Komoda. All buildings of any size are designed to withstand earthquake shocks.

Live Load on Roofs 6.15 lb.Sq.Ft.
" " " Office Bldgs. 61.5 lbs Sq.Ft.
Wind Load-vertical surfaces 20.4 lbs Sq.Ft.
Tensile and Compressive strenght of structural steel 17,100 lbs per Sq.In.
Ultimate tensile stress of structural steel 52,700 lbs.Sq.In.
Design compressive strenght of concrete 640 lbs.Sq.In.
Compressive strenght of concrete after 28 days 1422 lbs to 2148 lbs Sq.In.

Earthquake Formula: K equals F/W equals A/G not less than 10% where K is factor;F is force,W is weight;A is acceleration due to horizontal force and G is acceleration due to gravity .
Unit cost of steel erected per ton 560 yen (yen@23.4cts.)
Unit cost of reinf.conc.Cu.Yd.in place 335 yen per Cu.Meter.

$K = \frac{F}{W} = \frac{A}{g} > 10\%$

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Notes by
C.K.Parker

Miscellaneous Notes
on
Target 1547 (Cont)

The engines were only tested at Akashi
(b) One third of the 128 Engines turned out at Akashi were watercooled. 60% of the assembly work on these engines was done at the Takatsuki plant of the Kawasaki Aircraft Co. and only the final 40% of the assembly work and the testing were done at Akashi.

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13. Description of Damage

The Kawasaki Aircraft Co. occupies 118.56 acres of land of which 84 acres is covered with buildings of all three category of vunerability. See plan_____ page _____ The main buildings are of the heavy mill type steel construction,with a few reinforced concrete structures and a large number of wooden buildings.

The target had been attacked in Jan 1945 with 500 H.E. bombs,following which the Japanese dispersed a large amount of their equipment mentioned previously. The target was also attacked twice in June with 4000# L.C.bombs having instanteneous ~~fuzes~~ noses and non-delay tail fuzes. This report covers only the structural and superficial damage caused by the 4000 L.C.bombs. Effort was made to assess only such damage from~~x~~ 4000# L.C. bombs as could be observed in the field. Superficial damage was 100% in nearly all cases. However this was not positively attributed to the 4000 lb.bombs,since no repairs had been made to buildings after the Jan 1945 raid. Building 8-a reinforced concrete structure of the fire resistive class and Building 19,a steel frame structure classed as non-combustible will be taken up in detail later in this report.

14. General Observation

The follwoing general observation may be made concerning the effects of the 4000# L.C. bombs. A bomb bursting in the plane of the lower chord of a roof truss in a steel frame building has atendency to knock over columns,with resultant wide spread distortion and collapsing of the building. Such area of distortion approximate 35,000 Sq.Ft. per bomb in a one story structure. (b)Fragmentation was a very minor cause of damage and did not contributed to the structural damage of the building. That is,given the effect of the blast,fragmentation caused no appreciable additional damage. (c)Evidence of damage due to shock could not be determined in steel buildings. (d)In reinforced concrete buildings damage was due to destruction of beams,columns and slabs in the immediate vicinity of the bomb,with cracking apparent in corners at distances of two bays(approximately) from the bomb.