ATLANTIC CITY OCTOBER 2001

A STUDY OF FACTORS INFLUENCING THE EVACUATION OF OCCUPANTS IN FIRE RELATED ACCIDENTS

THE EVACUATION OF OCCUPANTS IN FIRE RELATED ACCIDENTS

- The study was carried out on behalf of Transport Canada
- An analysis of past accidents using the CSRTG Accident Database

OBJECTIVES

To determine:

1) The proportion of non-impact injured passengers that evacuate the aircraft

2) The relative proportions of passengers evacuating through floor level and non-floor level exits

3) The reasons for non-impact injured passengers failing to safely evacuate the aircraft

OBJECTIVES

To determine:

4) The influence of door and assist means failure on passenger evacuation

5) The likely influence of undercarriage failure on evacuation capability

6) The likely influence of impact intensity on evacuation capability

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METHOD

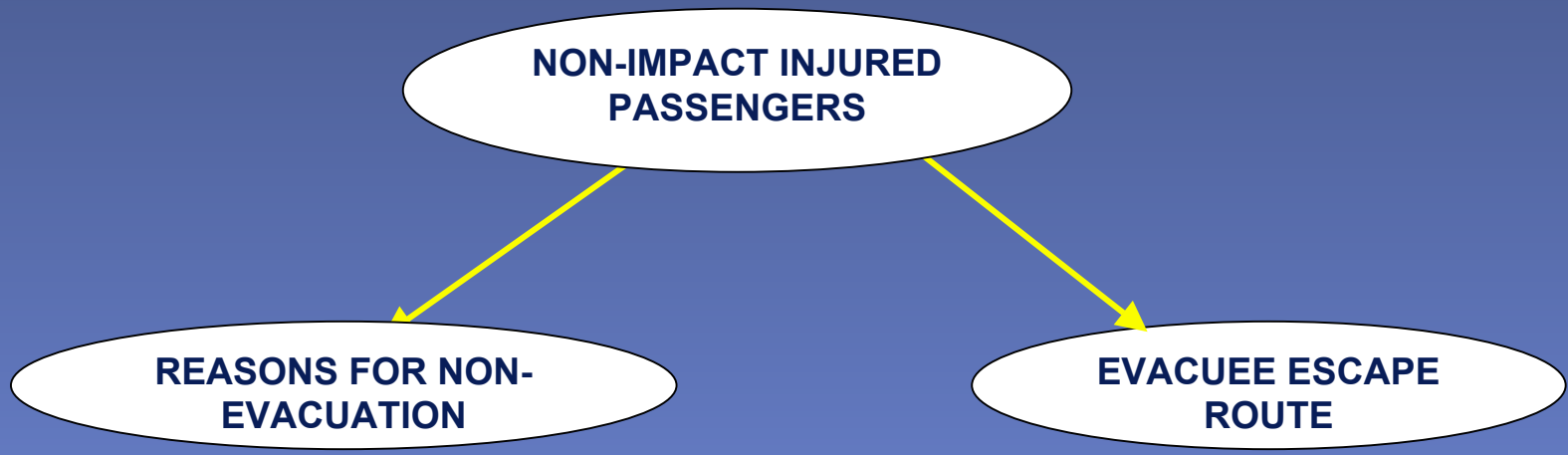
SELECTION OF ACCIDENTS FOR ANALYSIS

The selection of accidents analysed was based on the following criteria:

1) The Aircraft's Maximum Take-off Weight was greater than 12,500 lb.
2) The accident presented a significant fire threat to occupants
3) The accident was not 100% fatal
4) There was sufficient textual information available in the Accident Database

This resulted in 49 accidents

GENERAL METHODOLOGY



- MASSIVE AIRCRAFT DISRUPTION
- UNAVAILABILITY OF FLOOR LEVEL EXIT
- UNAVAILABILITY OF NON-FLOOR LEVEL EXIT
- FIRE STARTED IN FLIGHT AND PASSENGERS PROBABLY UNCONSCIOUS
- RAPID FIRE PROGRESSION WITHIN THE CABIN
- EVACUATION SLOWED BY FUSELAGE DAMAGE THEN FIRE
- RAPID FIRE PROGRESSION THROUGH FUSELAGE BREAKS
- UNKNOWN

- FLOOR LEVEL EXITS
- NON-FLOOR LEVEL EXITS
- FUSELAGE BREAKS
- OTHER (HATCHES WINDOWS ETC.)
- UNKNOWN

CRITERIA USED IN ANALYSIS

- Only Passengers were considered and not flight or cabin crew.
- Only passengers that were uninjured as a result of the impact were considered when determining evacuation routes.
- Passengers ejected from the aircraft as a result of the impact are considered as non-evacuees.

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RESULTS

PERCENTAGE OF NON-IMPACT INJURED PASSENGERS THAT EVACUATE THE AIRCRAFT

Aircraft fitted with non-floor level exits

68.0%

{Aircraft fitted with Floor level exits only

98.0%}

IMPACT INTENSITY

IT HAS BEEN FOUND
THAT IMPACT INTENSITY MAY BE GAUGED BY THE PROPORTION OF OCCUPANTS SUSTAINING OF SERIOUS AND FATAL INJURIES

$$= \frac{\text{NUMBER OF SERIOUS \& FATAL INJURIES}}{\text{TOTAL NUMBER OF OCCUPANTS}}$$

PASSENGER EVACUATION ROUTES

BREAKS	FLOOR LEVEL	NON-FLOOR LEVEL	OTHER (hatches, etc.)	UNKNOWN
298	919	366	7	93
17.7%	54.6%	21.7%	0.4%	5.5%

FLOOR LEVEL	NON-FLOOR LEVEL
71.5%	28.5%

REASONS FOR NON-EVACUATION OF PASSENGERS

REASONS FOR NON-EVACUATION	NUMBER OF PASSENGERS	PROPORTION OF NON-IMPACT, FATALLY INJURED PASSENGERS	PROPORTION OF FATALLY INJURED PASSENGERS
UNAVAILABILITY OF FLOOR LEVEL EXIT	142	19.9%	12.4%
UNAVAILABILITY OF NON-FLOOR LEVEL EXIT	2	0.3%	0.2%
RAPID FIRE PROGRESSION WITHIN THE CABIN	365	51.2%	31.9%
RAPID FIRE PROGRESSION THROUGH FUSELAGE BREAKS	125	17.6%	10.9%
EVACUATION SLOWED BY FUSELAGE DAMAGE - THEN FIRE	34	4.8%	3.0%
FIRE STARTED IN FLIGHT AND PASSENGERS PROBABLY UNCONSCIOUS	23	3.2%	2.0%
MASSIVE AIRCRAFT DISRUPTION	19	2.7%	1.7%
UNKNOWN	2	0.3%	0.2%
TOTAL	712	100%	62.3%

FLOOR LEVEL EXIT FAILURES

	ALL ACCIDENTS		ACCIDENTS TO AIRCRAFT WITH NON-FLOOR LEVEL EXITS		ACCIDENTS TO AIRCRAFT WITH FLOOR LEVEL EXITS ONLY	
NUMBER ATTEMPTED TO BE OPENED	136		63		73	
NUMBER FAILING TO OPEN	24	18%	19	30%	5	7%
NUMBER OPENING BUT WITH RESTRICTION	10	7%	6	10%	4	5%
NUMBER OPENING	102	75%	38	60%	64	88%

NON-FLOOR LEVEL EXIT FAILURES

	ACCIDENTS TO AIRCRAFT WITH NON-FLOOR LEVEL EXITS	
NUMBER ATTEMPTED TO BE OPENED	46	
NUMBER FAILING TO OPEN	5	11%
NUMBER OPENING BUT WITH RESTRICTION	0	0%
NUMBER OPENING	41	89%

ASSIST MEANS FAILURES

	ALL ACCIDENTS		ACCIDENTS TO AIRCRAFT WITH NON-FLOOR LEVEL EXITS		ACCIDENTS TO AIRCRAFT WITH FLOOR LEVEL EXITS ONLY	
NUMBER ATTEMPTED TO DEPLOY	94		34		60	
NUMBER FAILING TO DEPLOY	9	10%	5	15%	4	7%
NUMBER DEPLOYING BUT WITH RESTRICTION	18	19%	9	26%	9	15%
NUMBER DEPLOYING	67	71%	20	59%	47	78%

UNDERCARRIAGE FAILURES

40 OF THE 49 ACCIDENTS STUDIED (APPROXIMATELY 80%) INVOLVED UNDERCARRIAGE FIRE

CONCLUSIONS

BASED ON A STUDY OF 49 ACCIDENTS IN WHICH THERE WAS SIGNIFICANT FIRE THREAT TO OCCUPANTS

1. **THE PROPORTION OF NON-IMPACT INJURED THAT EVACUATE THE AIRCRAFT IS TYPICALLY 68%**

2. **IN THE REGION OF 20% to 30% OF EVACUEES USE NON-FLOOR LEVEL EXITS**

3. **THE PRIME REASON FOR NON IMPACT INJURED PASSENGERS FAILING TO EVACUATE THE AIRCRAFT ARE RAPID FIRE PROGRESSION ALTHOUGH UNAVAILABILITY OF FLOOR LEVEL EXITS ARE ALSO SIGNIFICANT**

CONCLUSIONS

BASED ON A STUDY OF 49 ACCIDENTS IN WHICH THERE WAS SIGNIFICANT FIRE THREAT TO OCCUPANTS

4. APPROXIMATELY 75% OF FLOOR LEVEL EXITS THAT ARE ATTEMPTED TO BE OPENED ARE OPENED AND 90% FOR NON-FLOOR LEVEL EXITS

5. APPROXIMATELY 70% OF ASSIST MEANS THAT ARE ATTEMPTED TO BE DEPLOYED FUNCTION EFFECTIVELY THROUGHOUT THE EVACUATION

6. IMPACT INTENSITY IS LIKELY TO HAVE A SIGNIFICANT EFFECT ON THE ABILITY TO OPEN FLOOR LEVEL EXITS