

Improper Loading: Causes and Consequences

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**... the fine art of creating an
inalterable in-flight safety
hazard, while safely on
ground**

What are we trying to avoid ?



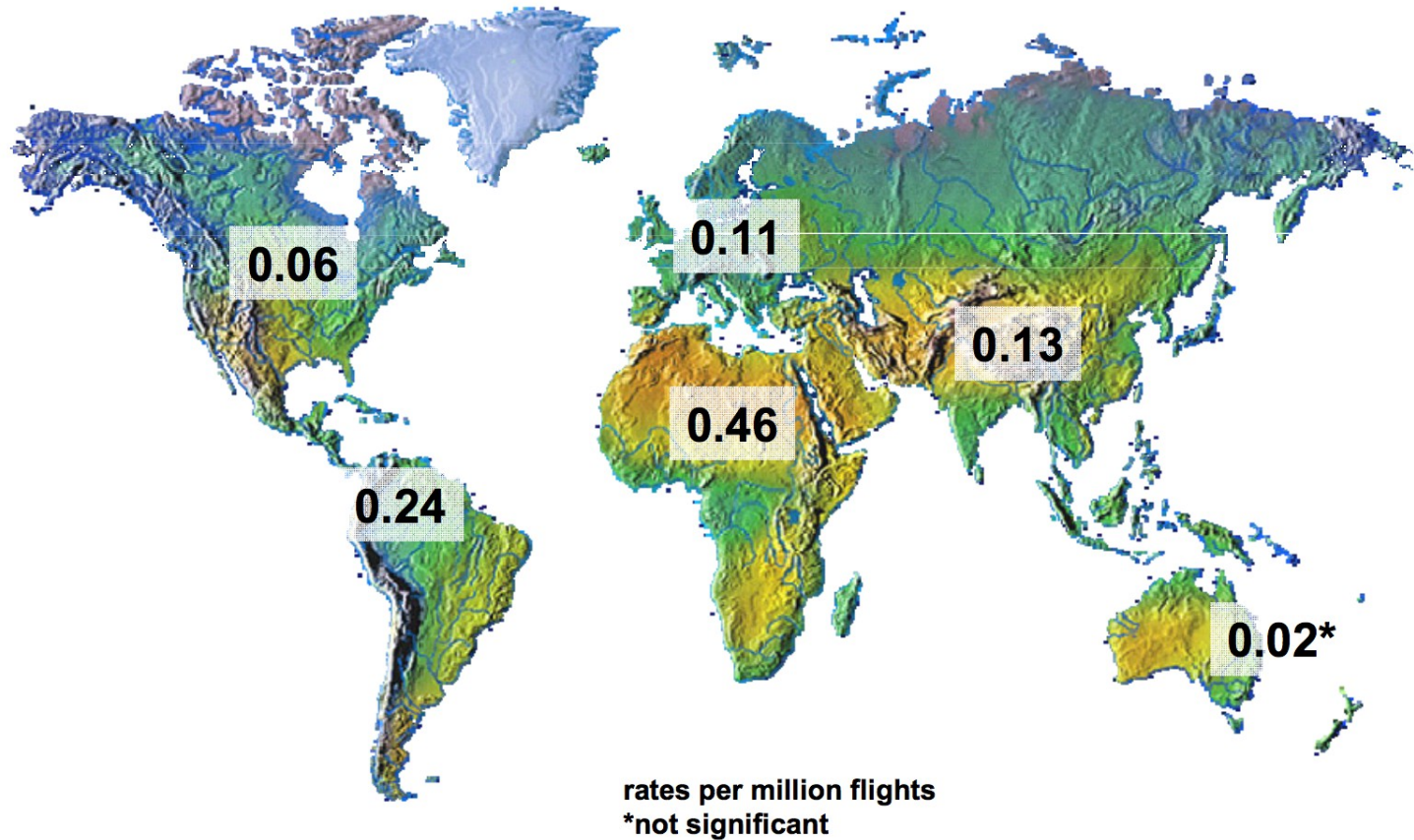
When are we creating a flight safety hazard ?

When the actual CG falls outside of the aircraft certificated envelope

When the actual mass exceeds certified loading limits

When the actual mass exceed the aircraft mass that would permit to achieve the required performance

Should we be concerned ?



Accidents directly related to weight & balance issue, 1970-2005, aircraft above 5'500 kg MTOM

Source: NLR Report TP-2007-153 "Analysis of aircraft weight and balance related safety occurrences,"

Realities and related fallacy

WFP operations are very demanding, take place in difficult areas with little flight support, this in very dynamic environments and changing conditions

The laws of mechanics and aerodynamics governing the safe operation on an aircraft are fixed and inalterable

... believing that there is some sort of waiver from the above laws, when the purpose of a flight is humanitarian or takes place in a difficult environment or in remote areas, is a very dangerous fallacy .

Improper loading will impact

Aircraft structural integrity

Aircraft performance

Aircraft stability

Aircraft controllability

Structural integrity – paperclip case study



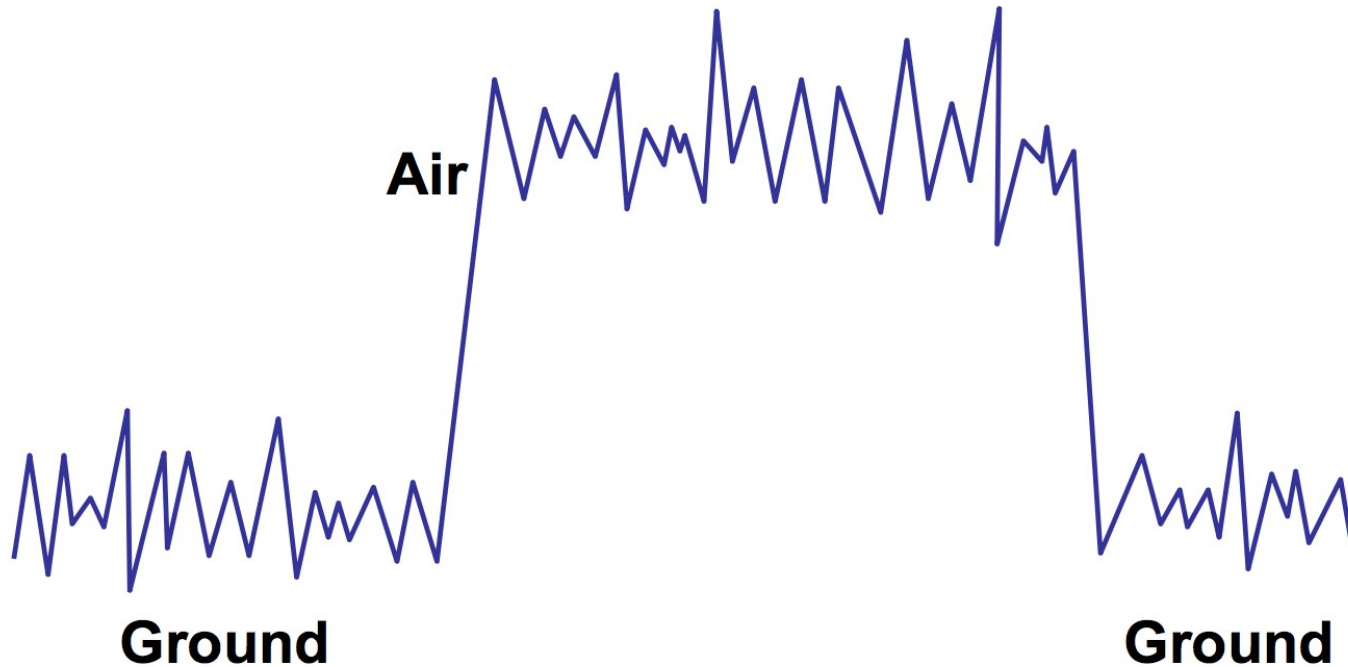
operated within its certified envelope, a paperclip will maintain its structural integrity throughout its calculated lifespan...

Structural integrity – paperclip case study



... however when subject to loads or cycles exceeding what has been planned for, premature structural failure is to be expected

Structural integrity – aircraft fatigue life



Increased stress on aircraft structure due to overload:

- ⇒ maintenance program inadequate ⇒ undetected premature aging ⇒ airworthiness not maintained
- ⇒ premature aging ⇒ development of local weaknesses ⇒ structural failure in normal operation .

Structural integrity – floor panels ... and below



Failing to achieve the necessary performance



- Engine fire in ICL, propeller could not be feathered, TOM 1'235 lbs above the MTOM of 26'200 lbs
- OEI ROC of 210 ft/min at MTOM reduced to 0 due to the overload (based on AAIB study)
- DC-3 hit terrain during emergency return
- W+B usually done in flight, pax and baggage not weighted, cargo manifest not given to the crew .

Failing to achieve the necessary performance



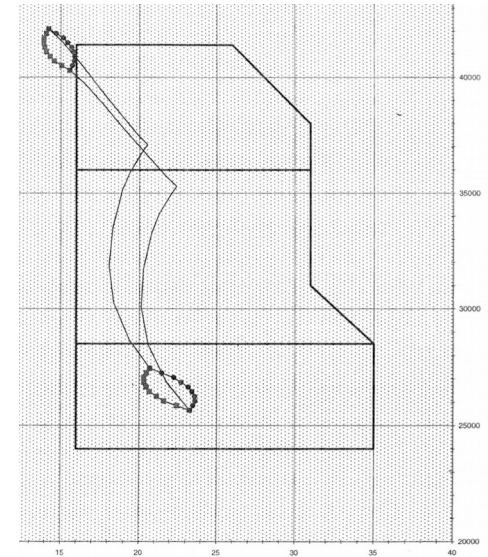
- B727 loaded in an anarchic manner, 160 POB (nb doubtful)
- Crew accustomed to inadequate loading manifest and absence of precise data on CG location
- TOM of 78 tons estimated by the crew with a CG at 19% (was around 85 tons with a CG at 14%)
- Unable to achieve normal take-off climb, struck a building 100 m after DER, crashed on the beach .

Stability ... and beyond



- Aeroplane loaded with CG out of aft limit, flight in an area of strong turbulences
- Pilot went to bathroom (?), shifting the CG further aft, aircraft became unstable, crew lost control
- Situation exacerbated by extreme turbulence, POB incapacitated by G-force shift, aircraft broke-up .

Controlability ... and the absence of it



- Aircraft loaded with CG ahead of forward limit, unable to rotate during take-off run
- No W+B calculation done (empty weight routinely modified by hand to a lower value by some crew)
- High speed RTO, ran off the DER at 110 kts through airport fence
- Continued across a 6 lanes highway (hit a vehicle), crossed a parking lot before impacting a building

Improper Loading Consequences

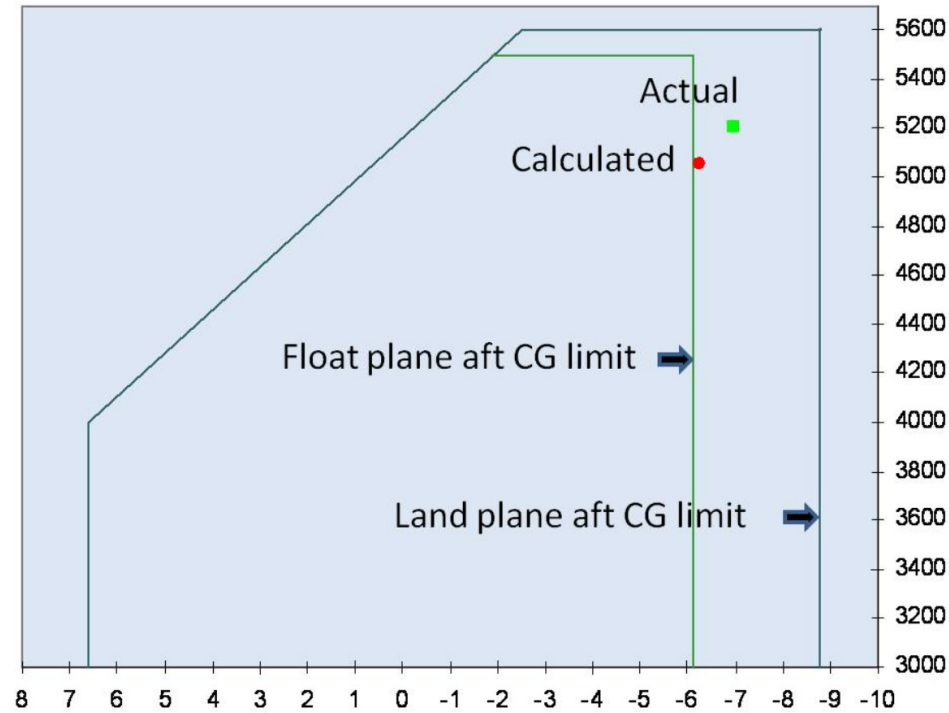
- Are unexpected and surprising
- Happen often in conjunction with unusual conditions
- Could hurt innocent crew during the life of the plane
- Will hurt innocent people on board or on ground

..... Is it what you want from your operation ?

Food for thought ...

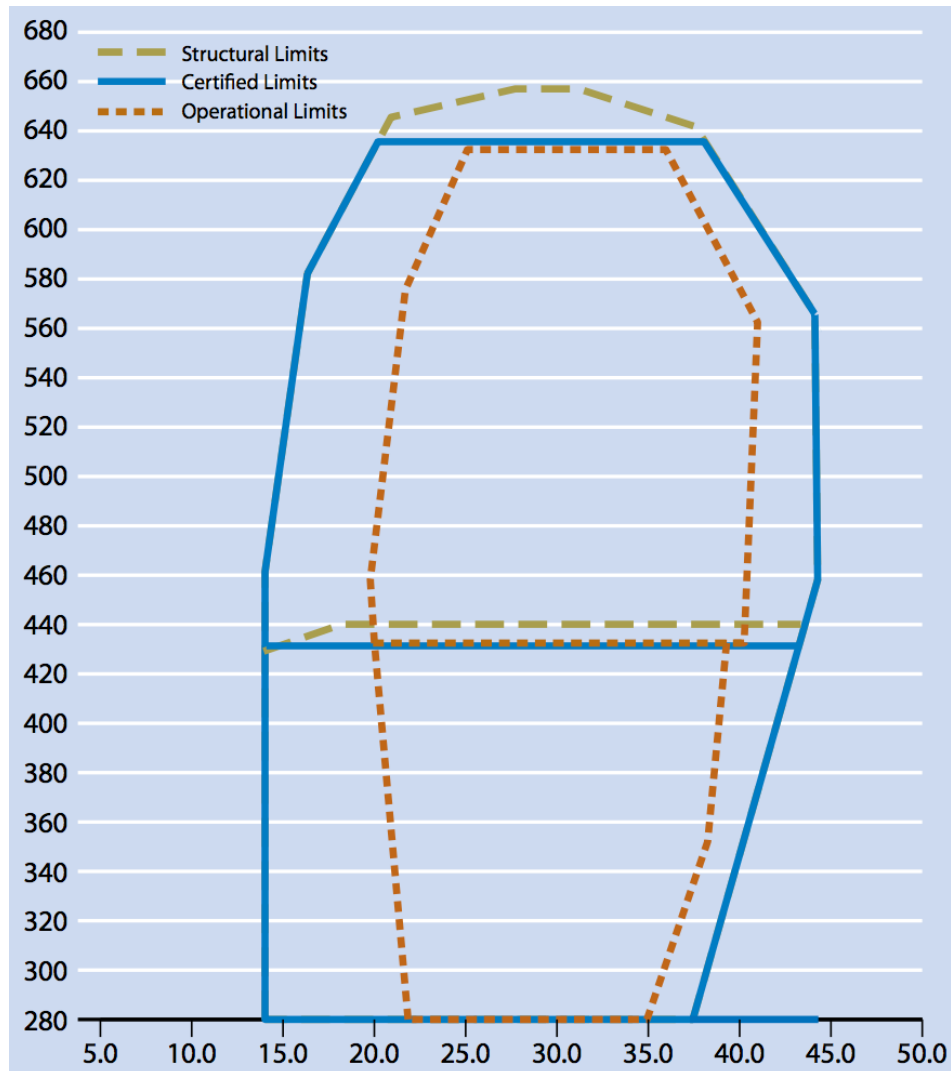
- It takes time and patience to create a great accident
- You can't prove you should do more before the accident ...
... but you will be proven wrong after the accident
- We don't crash, therefore we are doing it right ??????
- Humans tend to ignore future consequence for present gain .

Paper CG and its alterego in real life



... CG operational envelope ?

CG operational envelope concept



Improper Loading Causes

- Ignorance, absence of exposure, attitude, and aviation myths
- Compliance monitoring ... focusing on paper safety
- Inadequate processes:
 - Actual load weight control
 - Load weight and distribution variation
 - Effective weight and balance calculation tools .

Improper Loading Workshop

1 – Why do we (still) do it ?

2 – How big is the load ?

3 – Where is the load on board ?

4 – Monitoring the system

Thank you very much for your time