

Human Factors

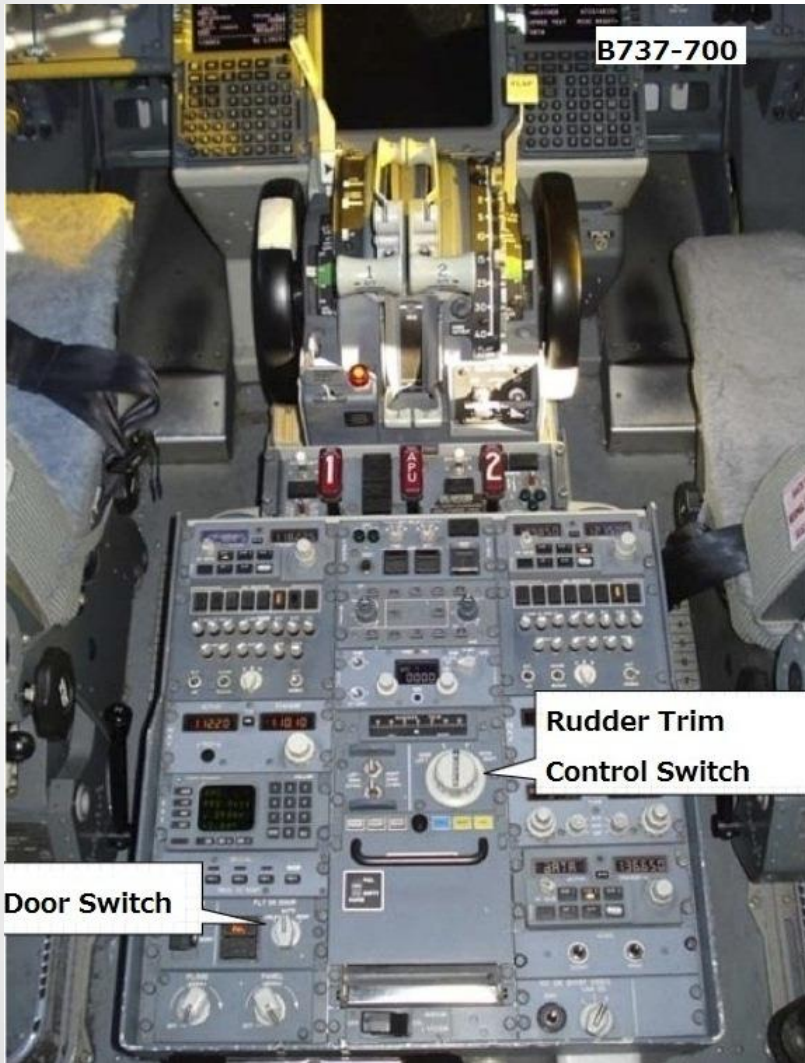
in airport design

H. Maekawa
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JICA Study Team

Current Topics : ANA Flight 140

- **A Passenger Airplane Flew Upside Down Because of a Dumb Pilot** (Media report)
- An All Nippon Airways Boeing 737-700, registration JA16AN performing flight NH140, 2011/09/06, from Okinawa to Tokyo Haneda (Japan) with 117 people on board, was en-route at FL410 about 23nm south of Hamamatsu (Japan) when the aircraft violently rolled left causing injuries to two flight attendants and descended by about 6000 feet leveling off at FL350 again. The flight continued to Tokyo's Haneda Airport for a safe landing. The two injured flight attendants were delivered to a hospital with flesh wounds.

Human Error : Ergonomics



"Identify", "Confirm" and then "Select"

Human Factors covers the Designs on:

- **Aircraft Equipment and Instrument, Ergonomics**
- **Air Traffic Control Procedures, System and Equipment,**
- **Aviation Regulations (Air Laws, Criminal Laws, etc.),**
- **Flight Manuals, Aeronautical Information Publication (AIP), NOTAMs**
- **Airport System and Airport Facilities,**
- **Maintenance Facilities,**
- **Airways Manuals, Flight Procedures,**
- **Aeronautical Charts, ATC Procedures,**
- **Rest, Sleep, Work Hours,**
- **Rescue, Life Saving,**
- **Training Regulations, Training Materials, CRM Training Materials**
- **Shift Work System, Pairings of Personnel, Personnel Recruiting**
- **and so on.**

Good Design ↔ Bad Design

*Good design applying
Human Factors principles
enhances*

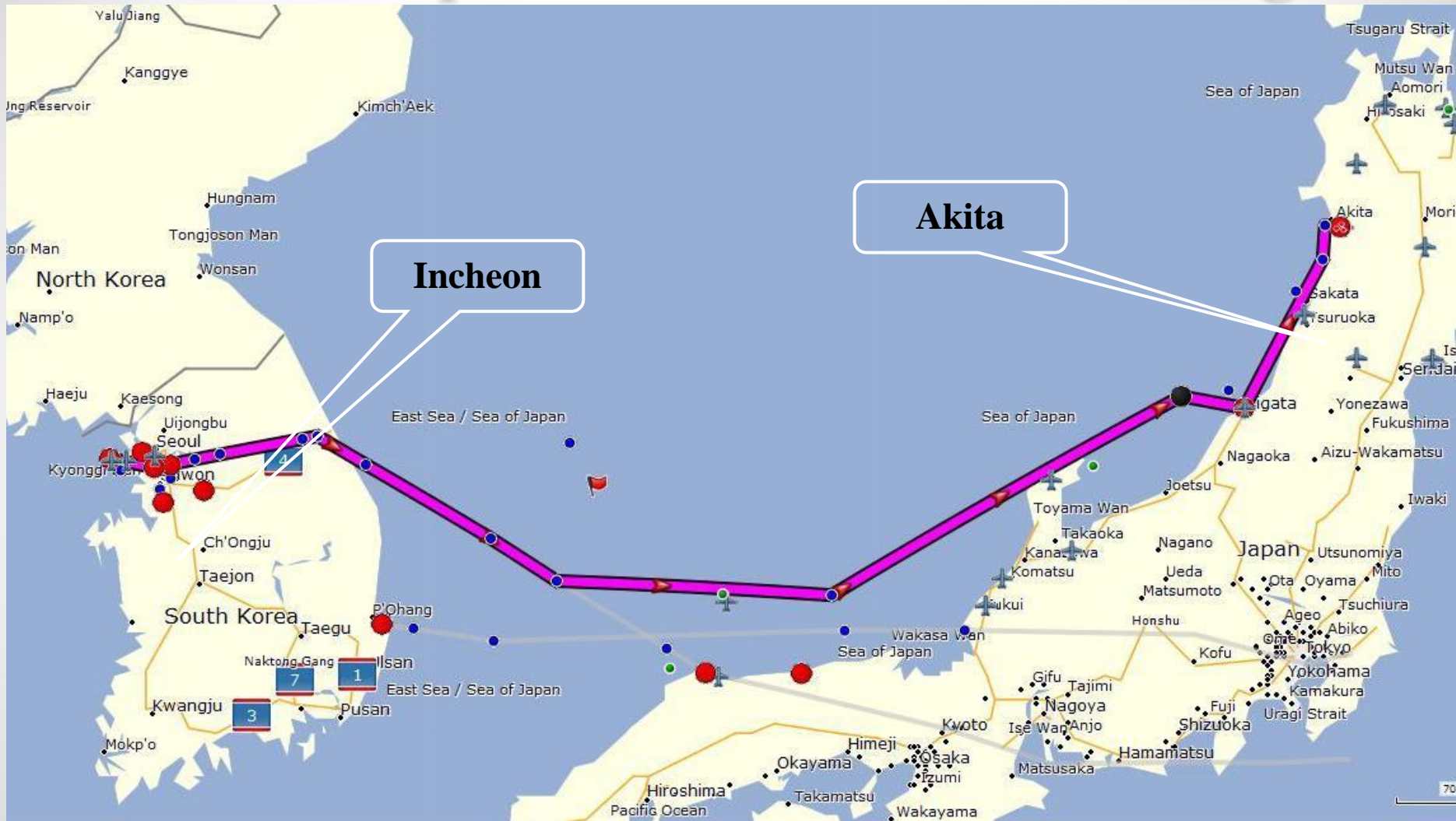
*Safety, Efficiency and Welfares
for the Human Operators.*

Okinawa, Japan --- Bad Location



Air Traffic must go on in an difficult situation!

Akita, Japan – Procedures Design




A case of KAL769, 2007/1/6 (5 days after Adamair574 B373 accident off Sulawesi)

Akita Rwy10 Approach

RJSK / AKITA

VOR Z RWY 10

SAPPORO CONTROL
127.575 - 315.3
120.575 - 277.1

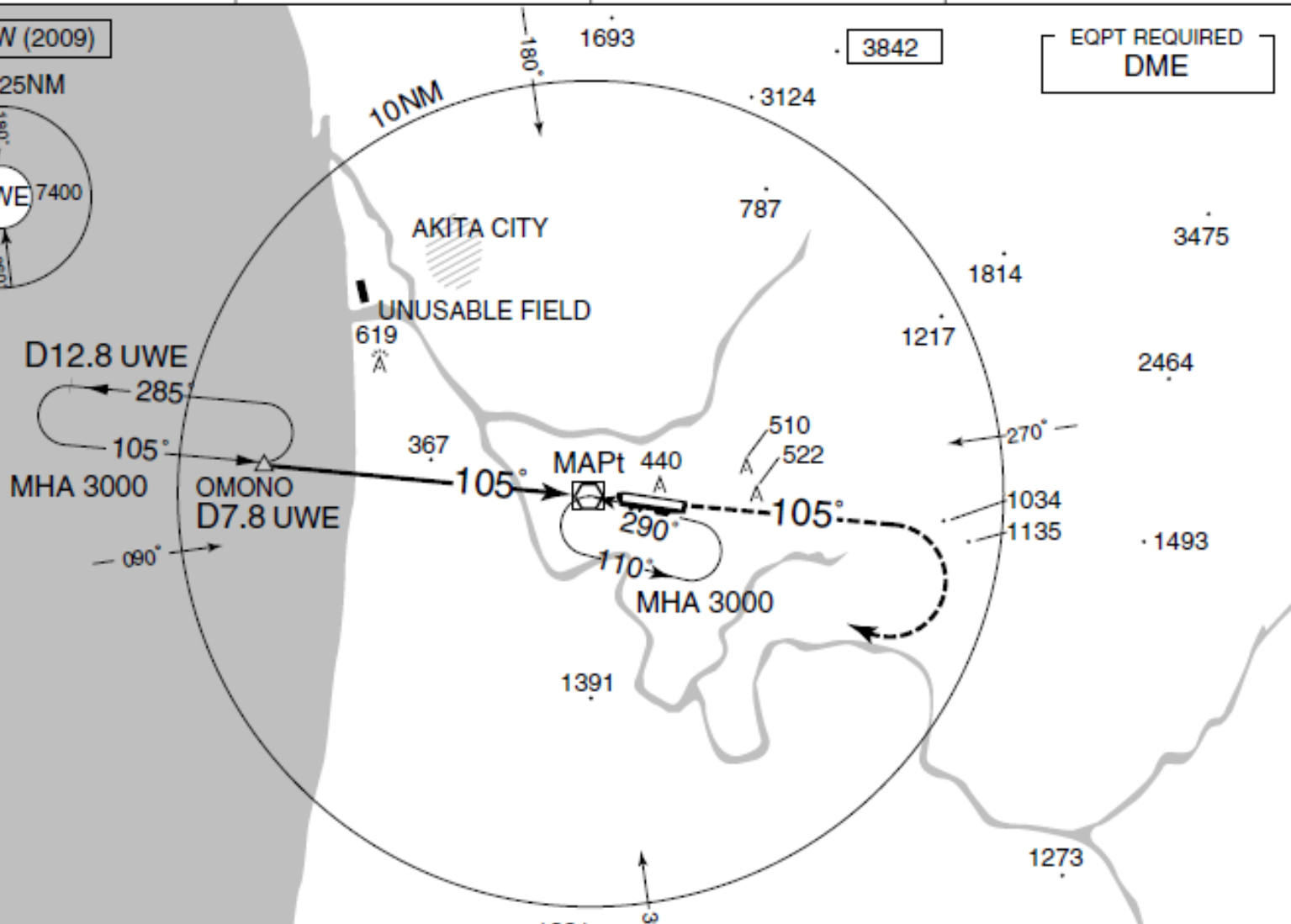
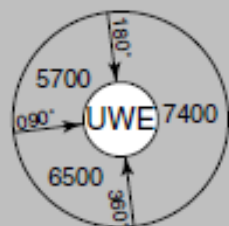
YUWA VOR/DME
110.65 UWE
CH-43Y 
39°37'02"N/140°11'13"E

AKITA TOWER
118.6 - 126.2

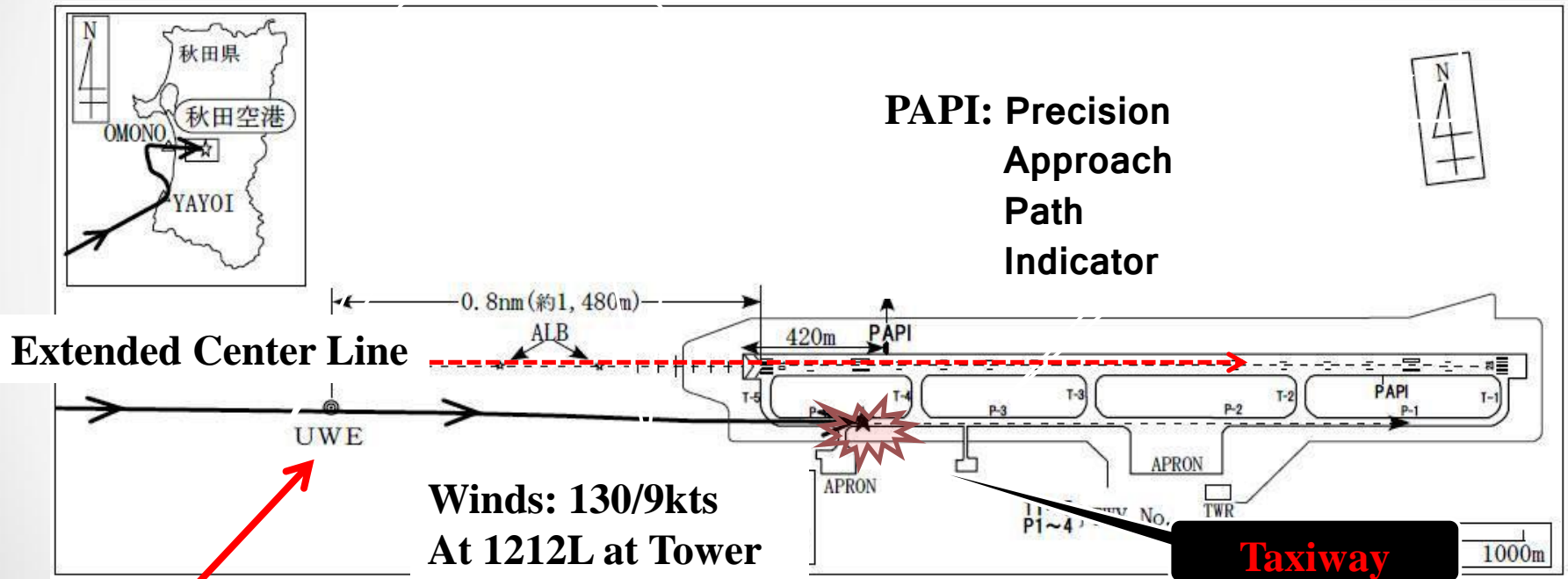
NO RADAR

VAR 8°W (2009)

MSA 25NM

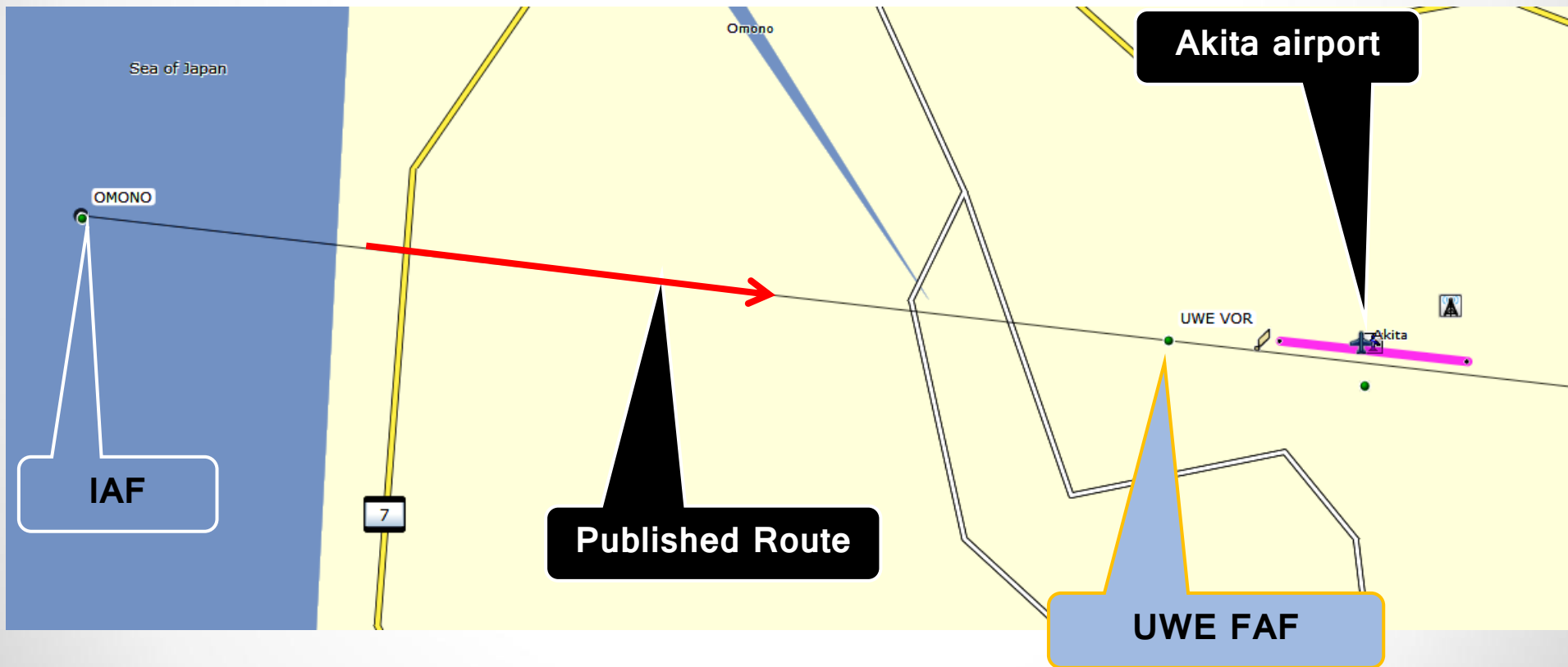


An Incident happened on Taxiway



After runway in sight,
make a left turn to land

Design inviting an error



Akita Airport, Japan

If you fly straight, you will reach TXY



Accident Investigation result

- Pilot's Error

Airline (KAL) :

- **Dismissed the pilot**

Human Factors : Bad Design

Palembang twy (old rwy) landing

- **Pilot's Error, but,,,**



KNKT.088.100.200.04

Human Factors : Bad Design

Padang, Indonesia

Padang needed
a new location for new
airport:
Away from the constraints
at the old airport of Tabing



Selection of location

Legal, but
Human Factors:
Bad design

RWY angle:
If twisted
10 more
degrees, ,,



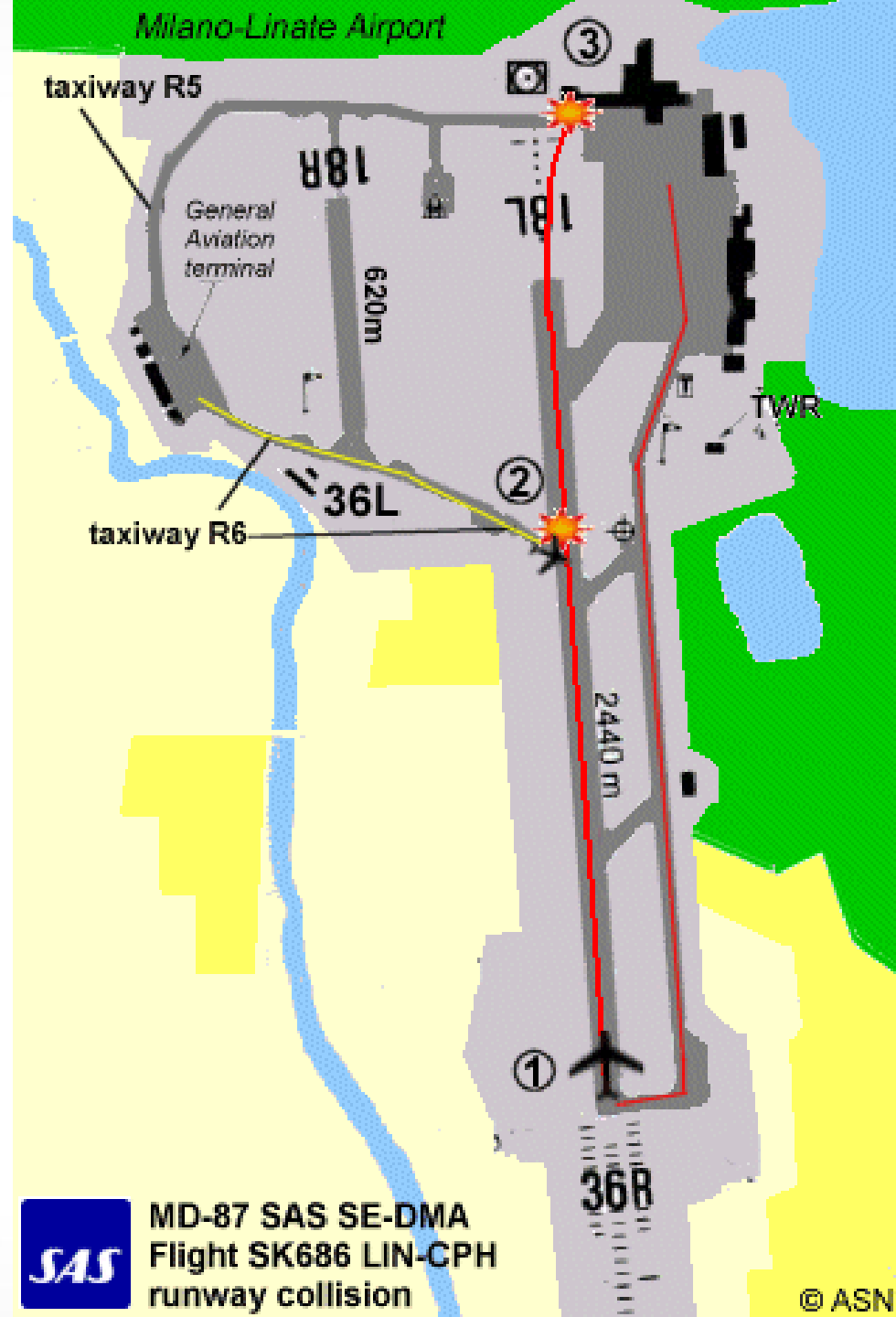
Linate, Italy

2001, Runway Incursion Accident.

Confusing, error inducing airport layout, but Regal.

Human Factors:

Bad design, - needs
IMPROVEMENT



Mangalore, India



Cliff

Runway where an OVER-RUN accident happened.
Aircraft fell at RED circle (Photo IND DGAC)

Result

- Of the 160 passengers and six crew members on board, only eight passengers survived.
- On 16 November 2010, five months after the Court of Inquiry was constituted, it submitted its report and stated that **pilot error** was the cause of the accident since the flight path was incorrect.
- Regally Correct.
- Human Factors: Bad design. If some safety devices were employed, it could have saved a lot of lives.

EMAS for example

Engineered Materials Arresting System



Legally: Not mandated.
Saved lives when an Overrun incident happened
Human Factors: **Good design.**

Yeager airport in Charleston, West Virginia

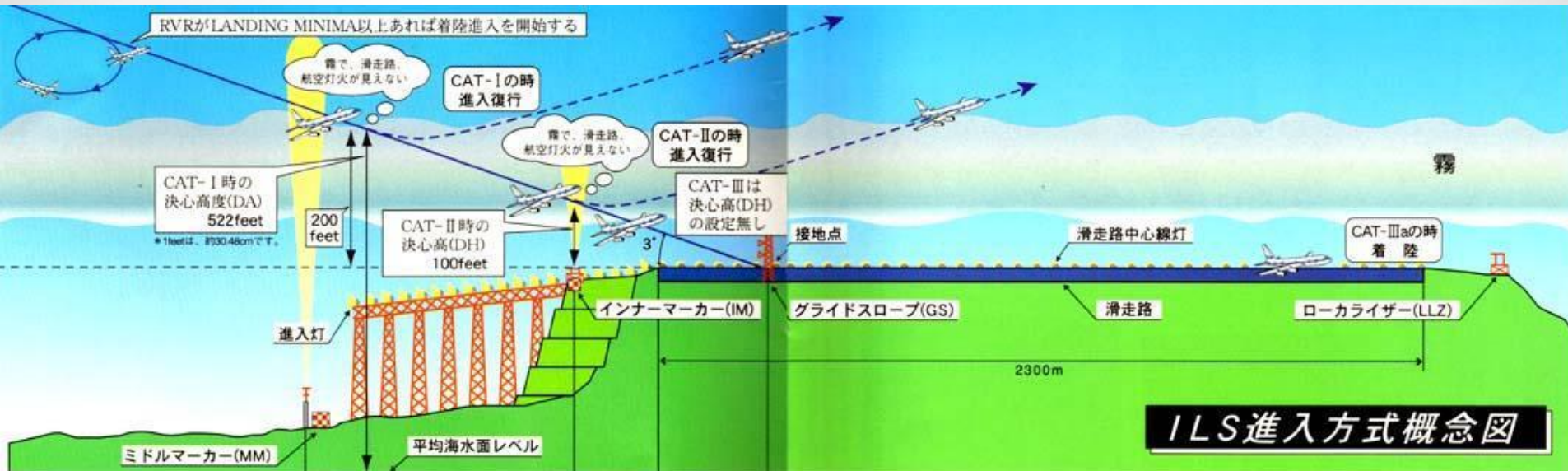
EMAS : SWA B737 at KBUR



Nose gear stuck in EMAS



Kushiro Airport, Japan



釧路空港計器着陸装置による方式概念図 (出典:国土交通省)

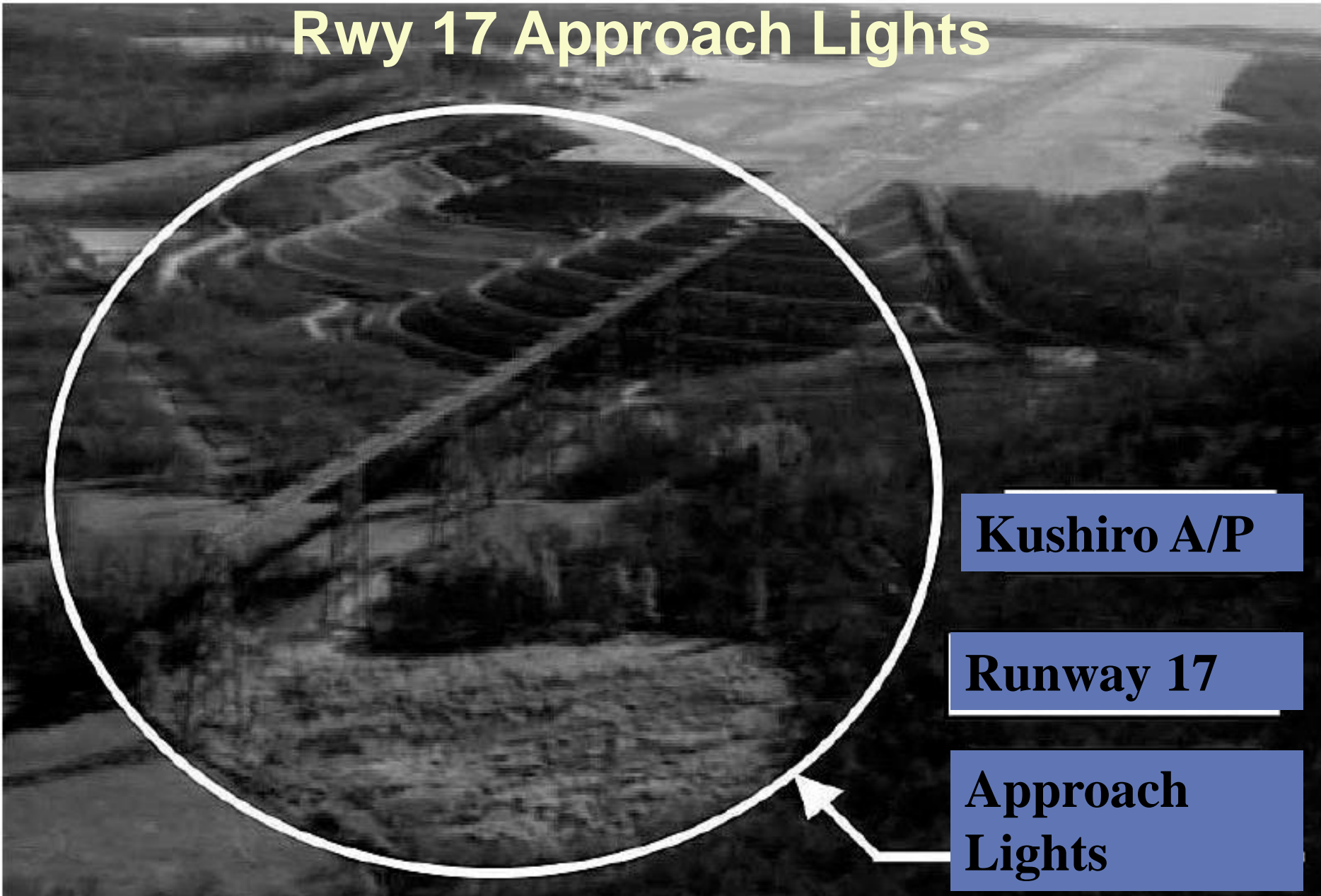
An air port in Hokkaido Japan,
Looks more like a aircraft carrier flight deck

Kushiro Airport (Hokkaido) Aerial View



Kushiro Airport (Hokkaido)

Rwy 17 Approach Lights

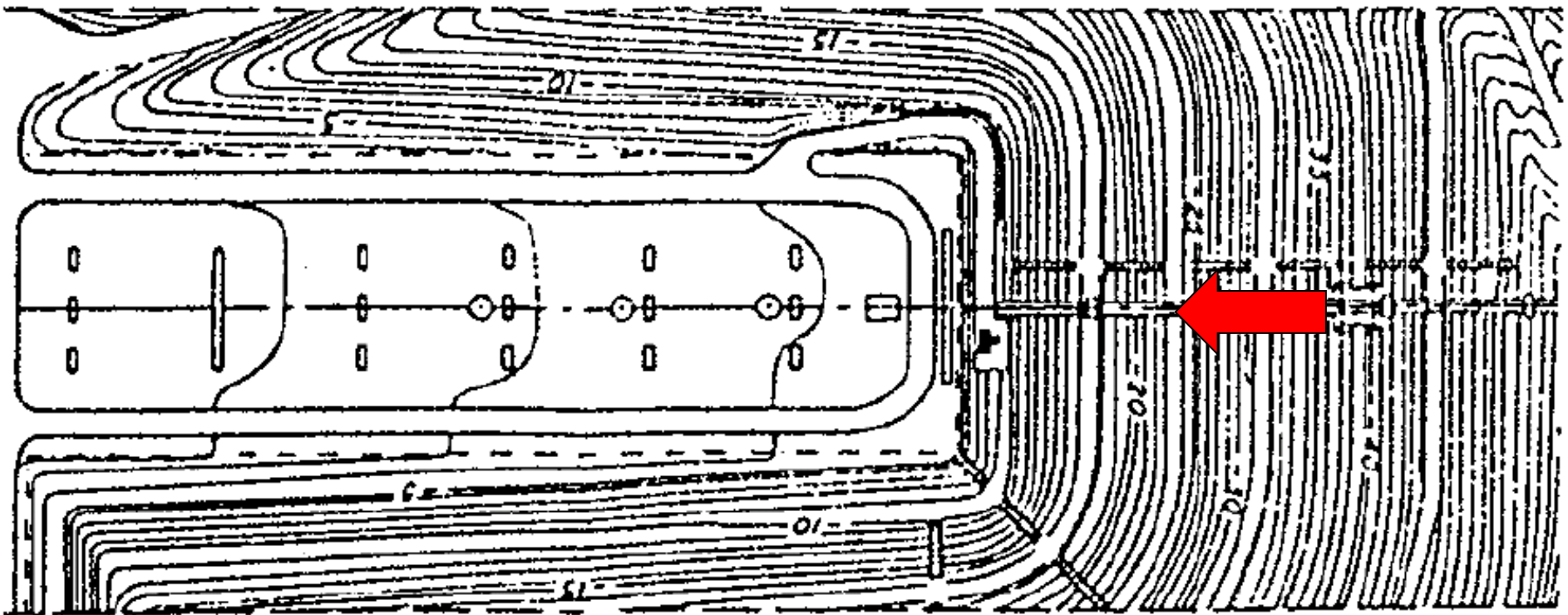


Kushiro A/P

Runway 17

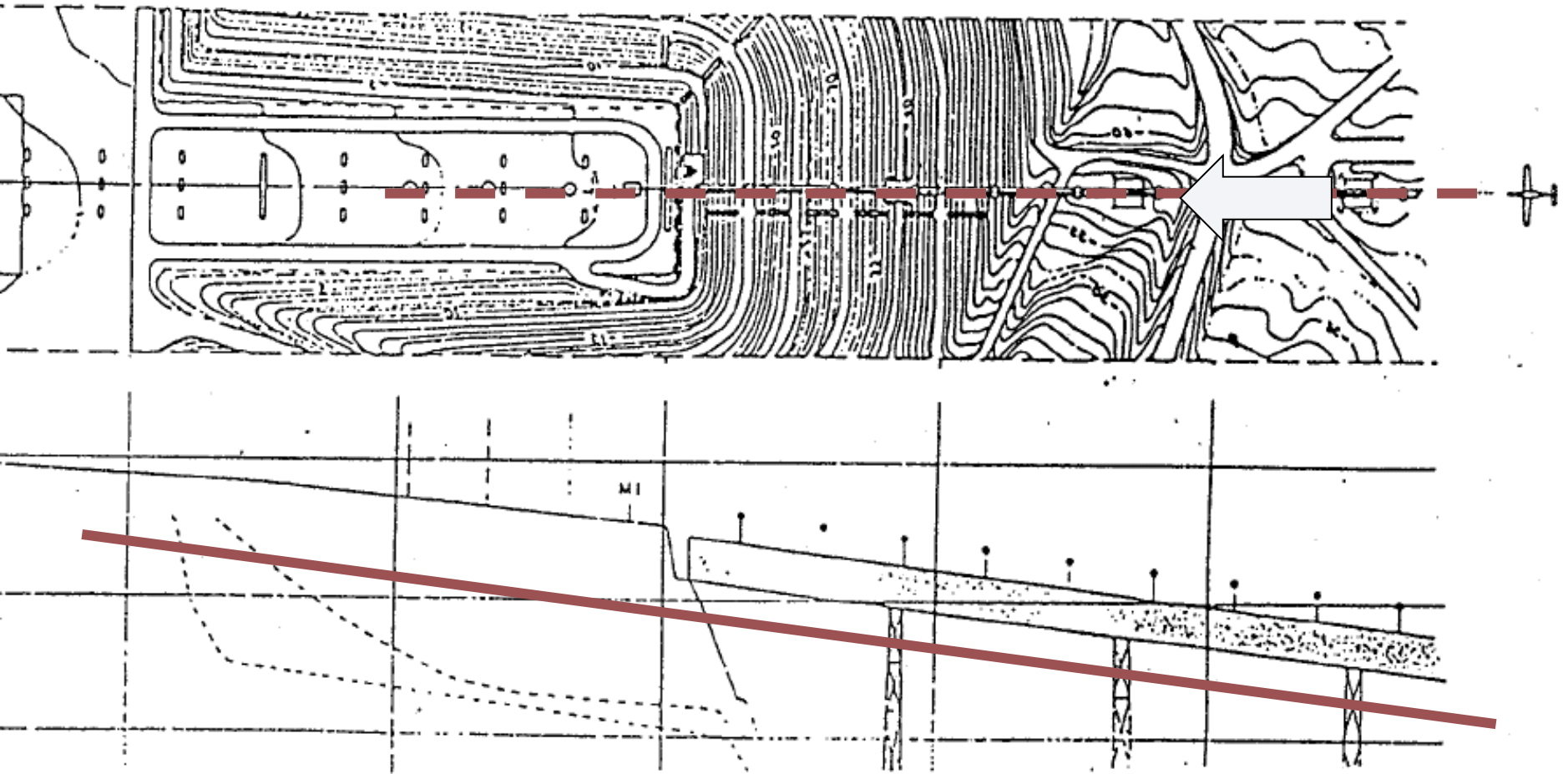
**Approach
Lights**

Kushiro Airport (Hokkaido) Rwy 17 Apc lights & Embanked Slope



Dense contours indicate steep slope

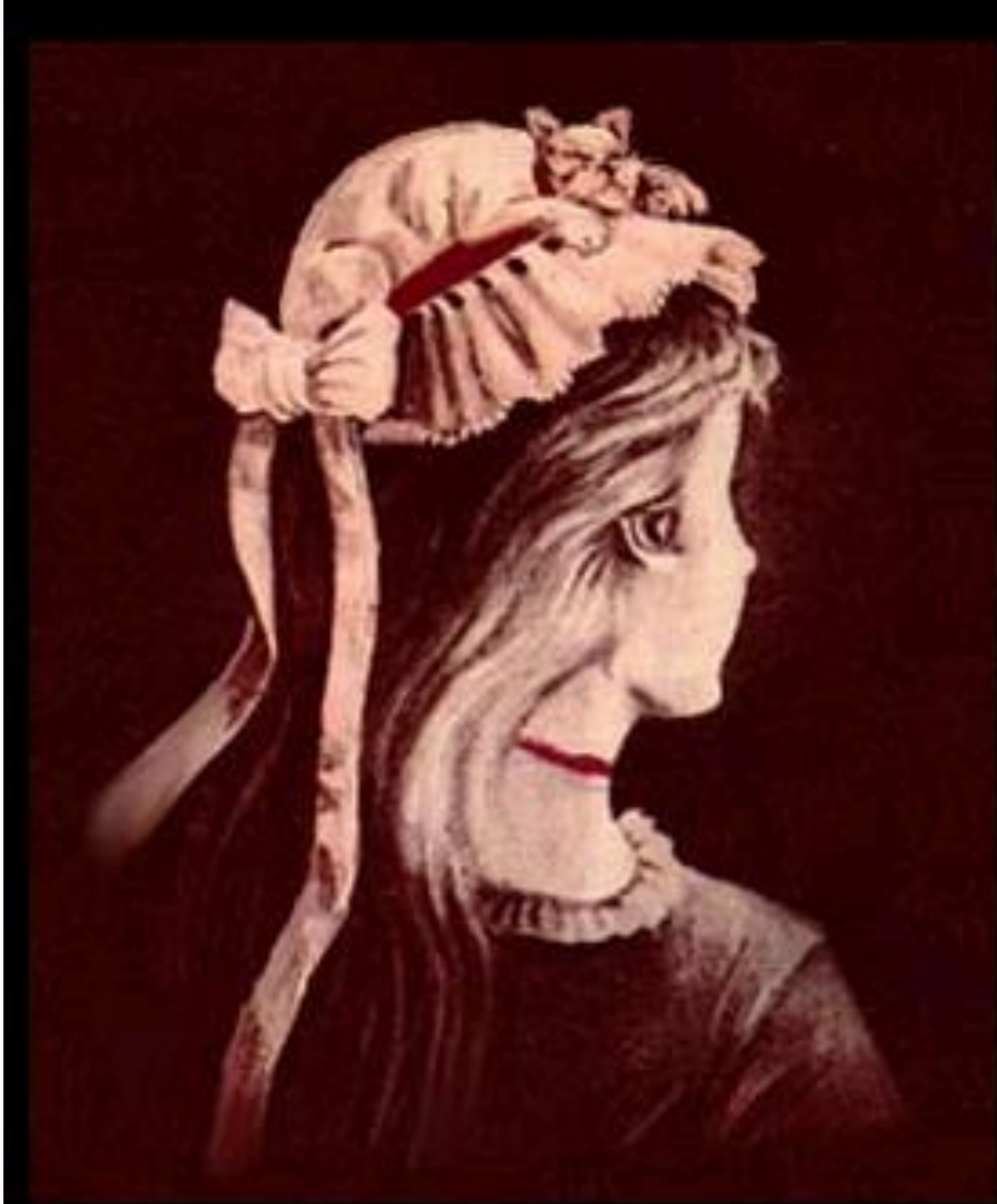
Rwy 17 Approach Light System



Human Factors Classic

What do
you see in
this?

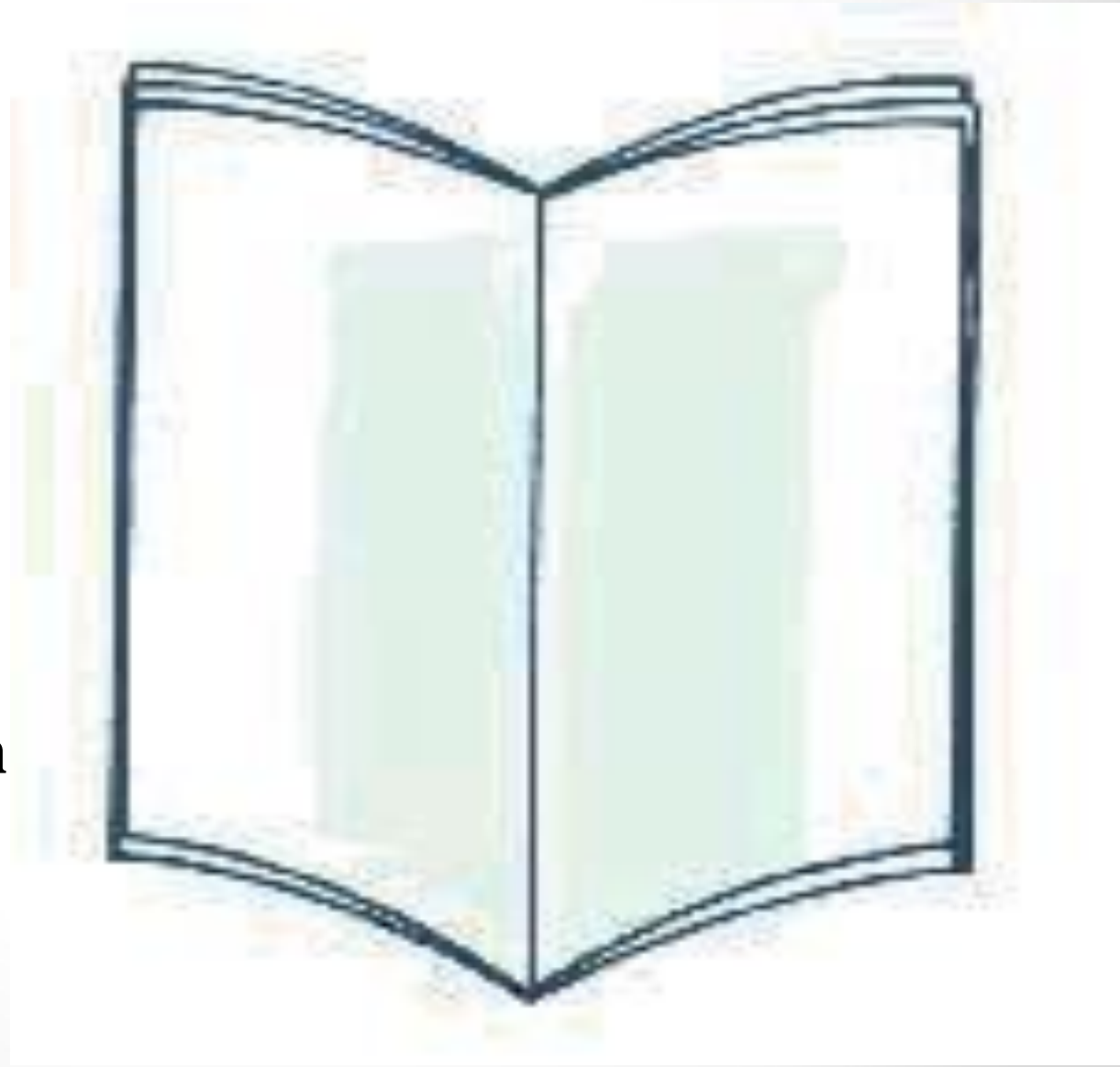
It depends!



What do you see in this?



Is the book toward you?



**Human perception
is not always same**



Kushiro Airport (Hokkaido)

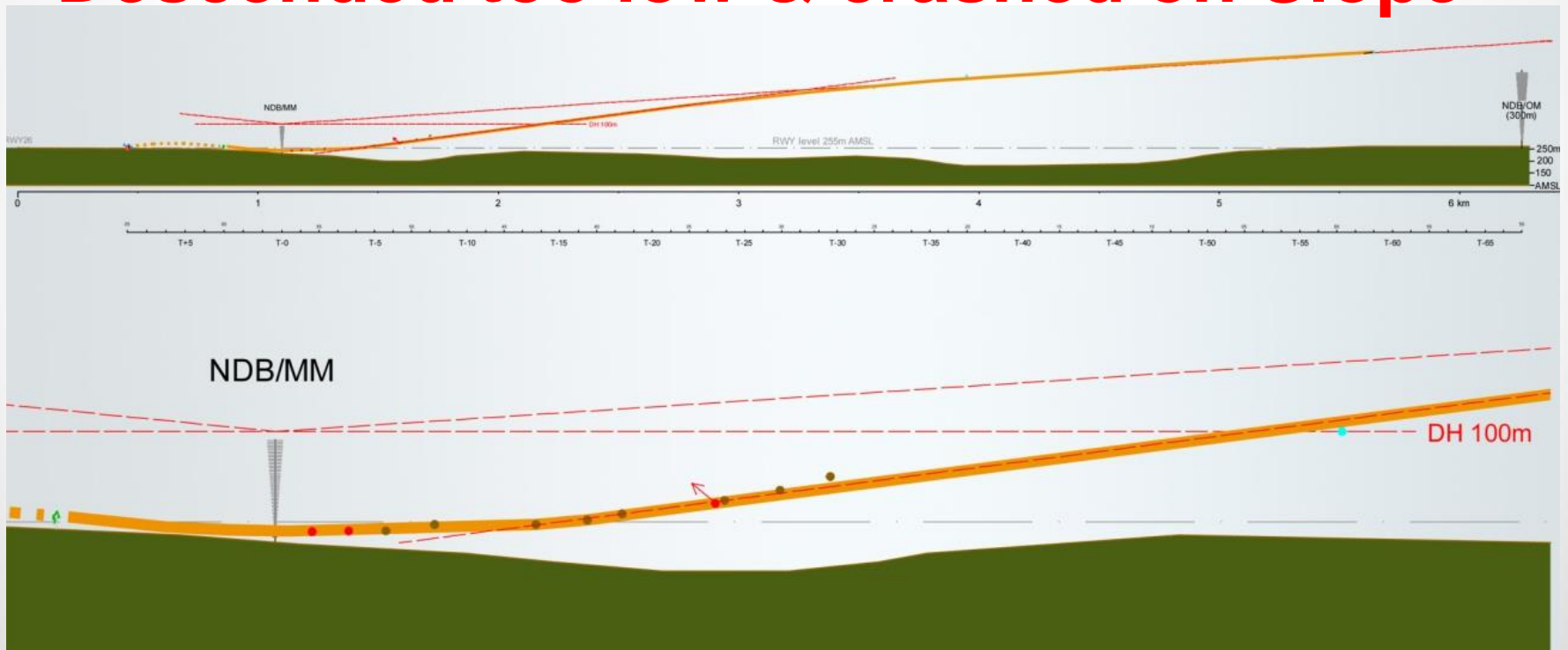
Rwy 17 view on final approach



Smolensk, Russia

Terrain slope

Poland Air Force Tu-154 Descended too low & crashed on Slope



Hiroshima Airport RWY28



Human Factors practice

- **the new air traffic control tower at Miami International Airport, where support columns obstructed the air traffic controllers' view of some parts of the runway, ramps and even approach paths of the planes.**
- **Responding to concerns of air traffic controllers that the tower posed serious safety risks, the Federal Aviation Administration said it would demolish the control booth of the new tower and rebuild it to give the controllers a clearer field of vision.**

Cost \$18–million, additional \$4–million for redesign

FAA Criteria Improved

Implemented many Human Factors principles in:

- **Design Policy**
- **Value user's requirements**
- **ATCT Site Location**
- **ATCT Tower (Controller's Eye) Height**
- **Configuration**
- **Orientation (especially in high latitude area)**
- **View/Critical sight lines**

ATCT Location

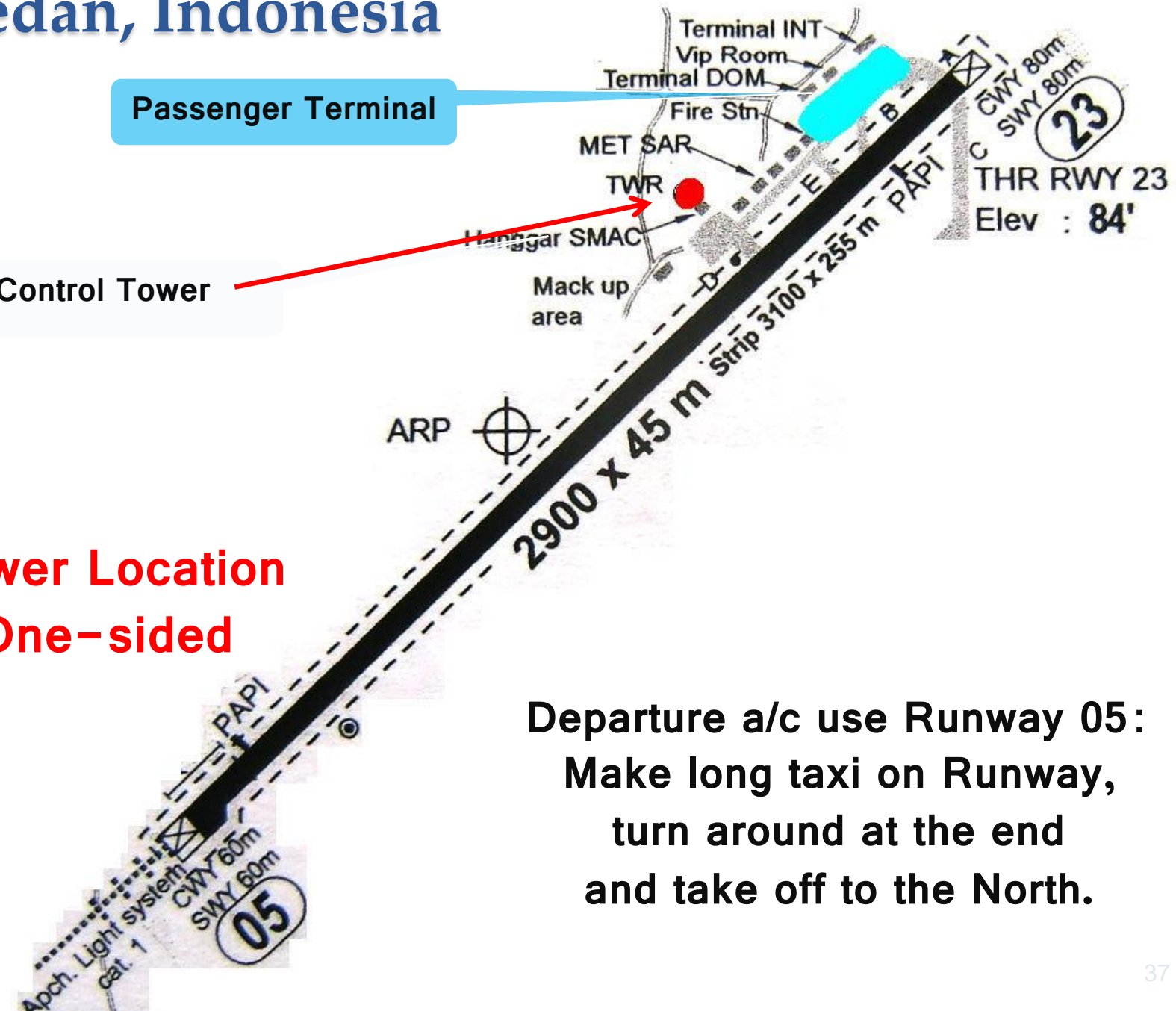
- Air Traffic Control Tower (ATCT) location is a very important factor in Airport Design

Medan, Indonesia

Passenger Terminal

Control Tower

Tower Location
One-sided



Departure a/c use Runway 05:
Make long taxi on Runway,
turn around at the end
and take off to the North.

ATCT Location (VTBS)



Bangkok (VTBS) Tower

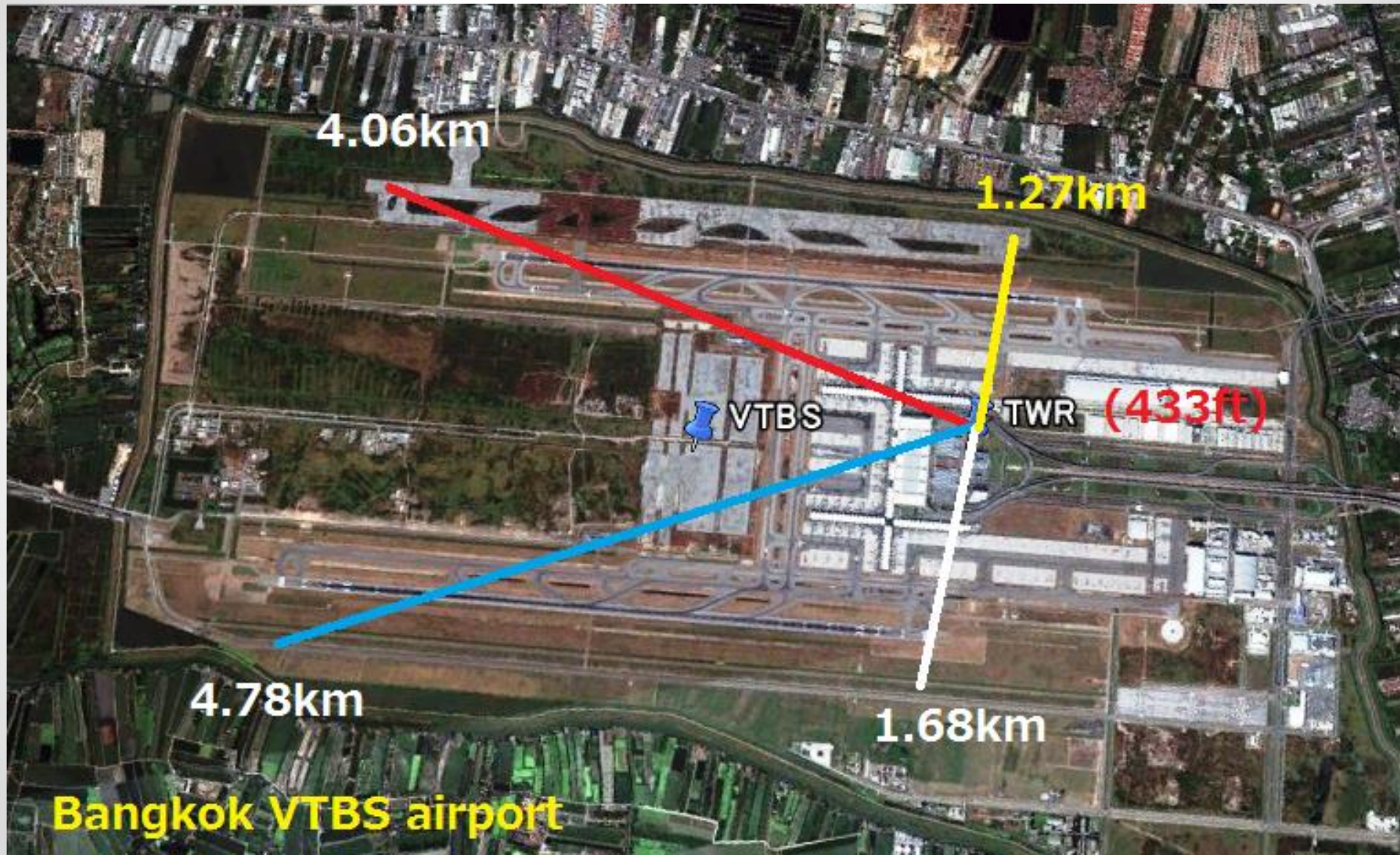
132m/433ft AGL

Ref: MONAS 137 m

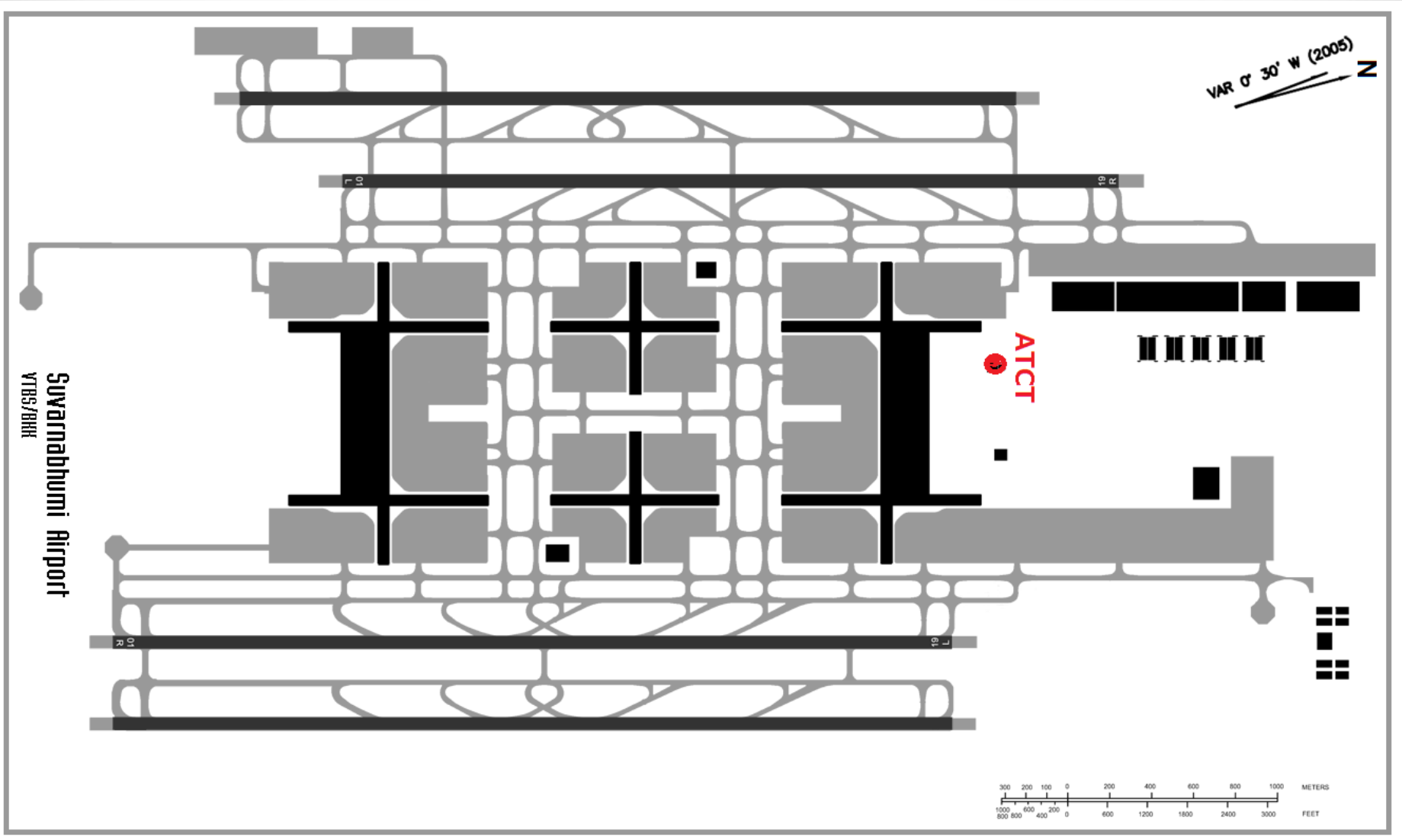
Bangkok VTBS TWR location



Bangkok VTBS TWR distance



Bangkok Future Plan



Singapore TWR



Singapore TWR



78 m (256 ft)

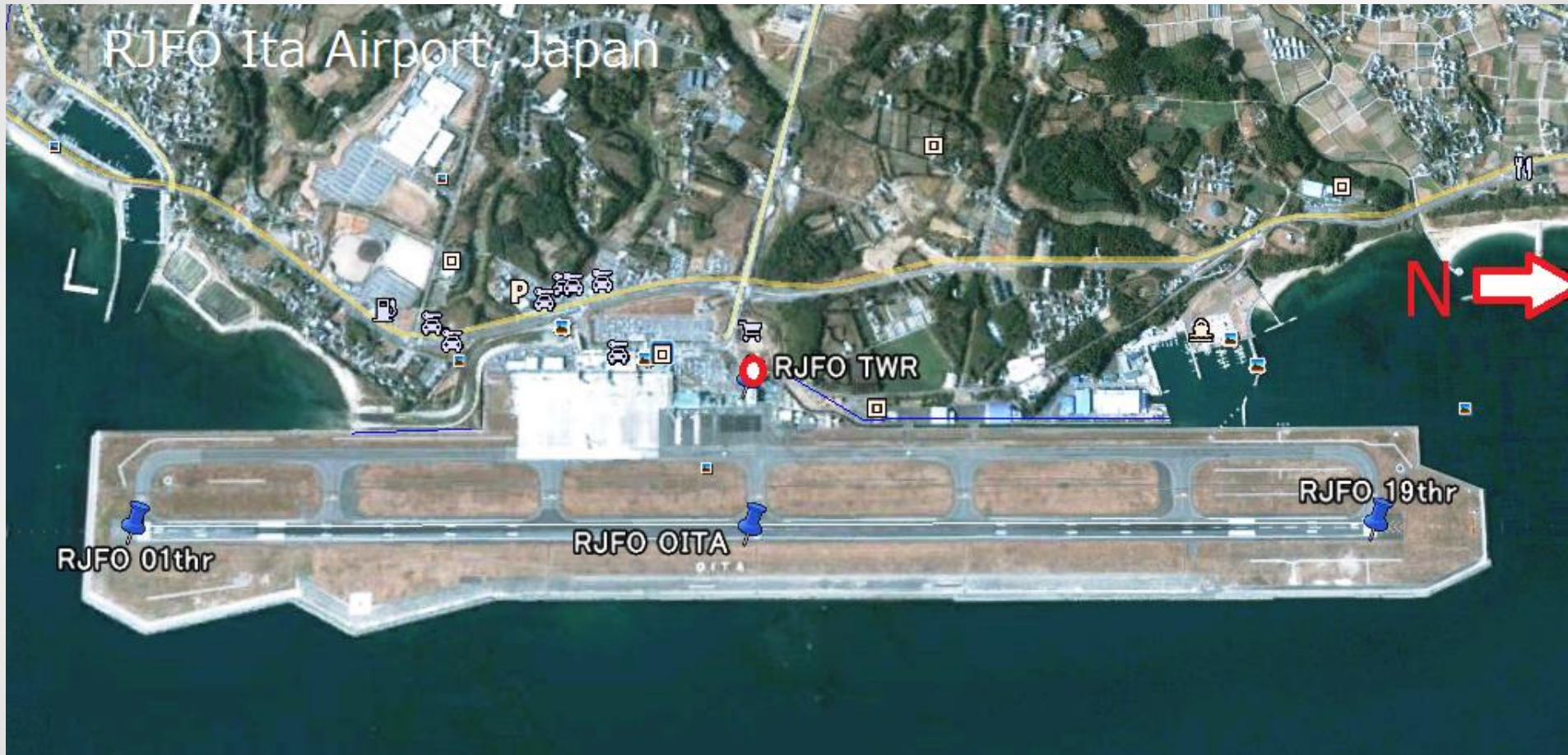
Singapore TWR with new RWY



Singapore TWR with new RWY

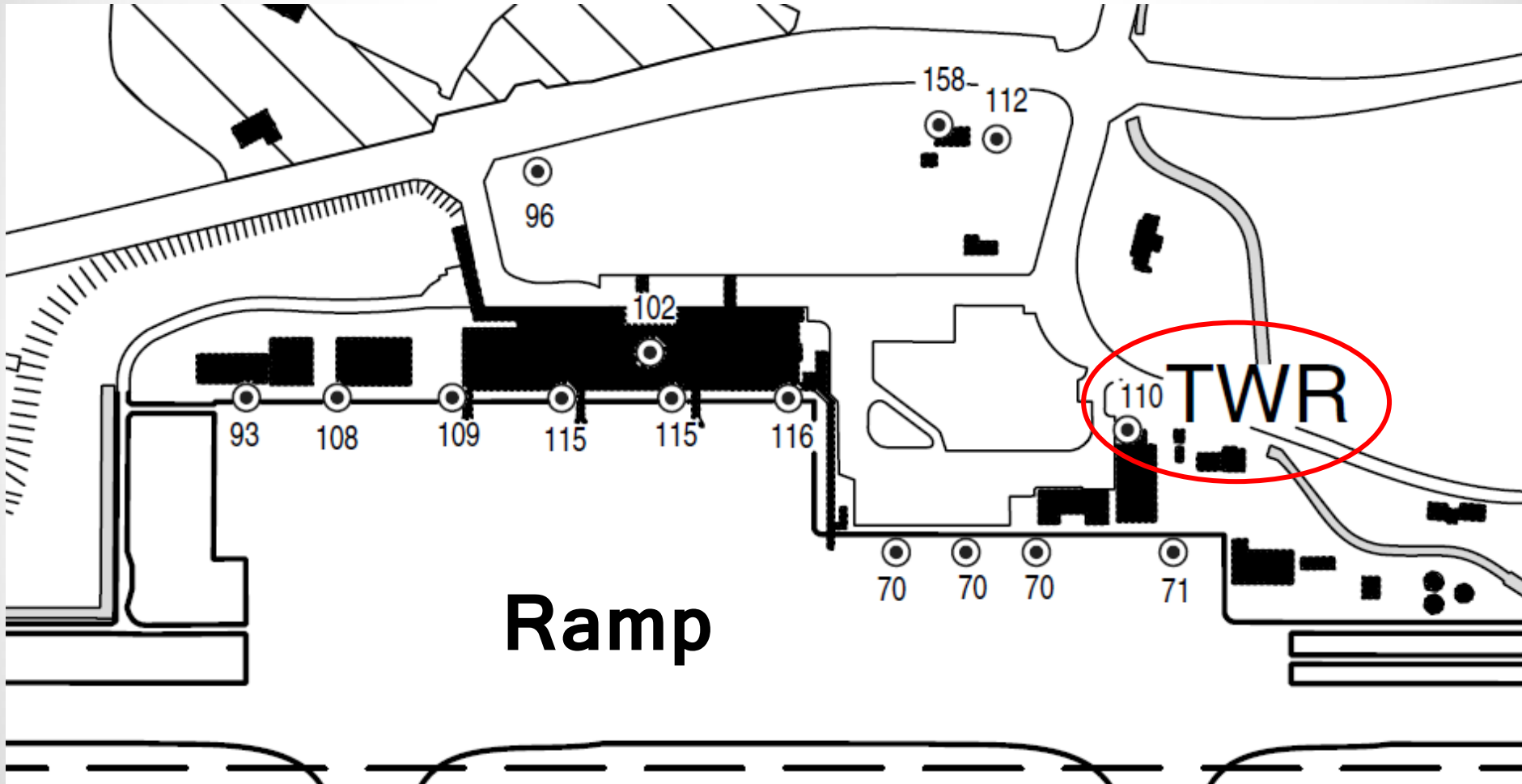


RJFO Oita TWR, Japan



Control Tower location remain way behind due to “Restriction Surface”

RJFO Oita TWR, Japan



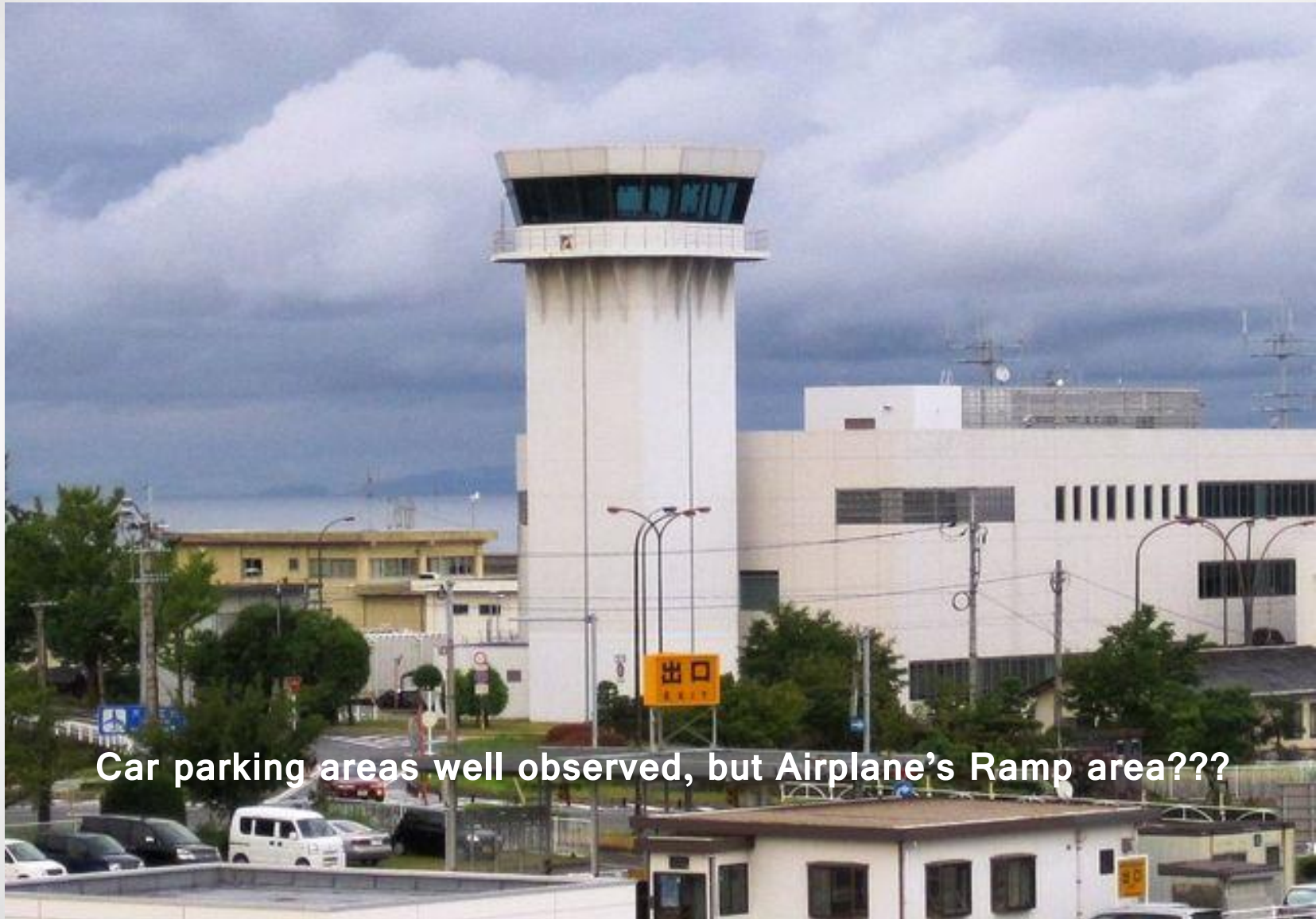
Ramp

Runway

Oita's modest tower



Oita's modest tower



Car parking areas well observed, but Airplane's Ramp area???

- **Regally compliant, but,,,,, Bad Design**

Human Factors / Safety Management System Group

- **Human Factors/**
- **Safety Management System
Group should collect information
and try hard to improve**

Let's take a brief look at JKT CGK Airport



A near ideal airport design

WIII JKT CGK Airport

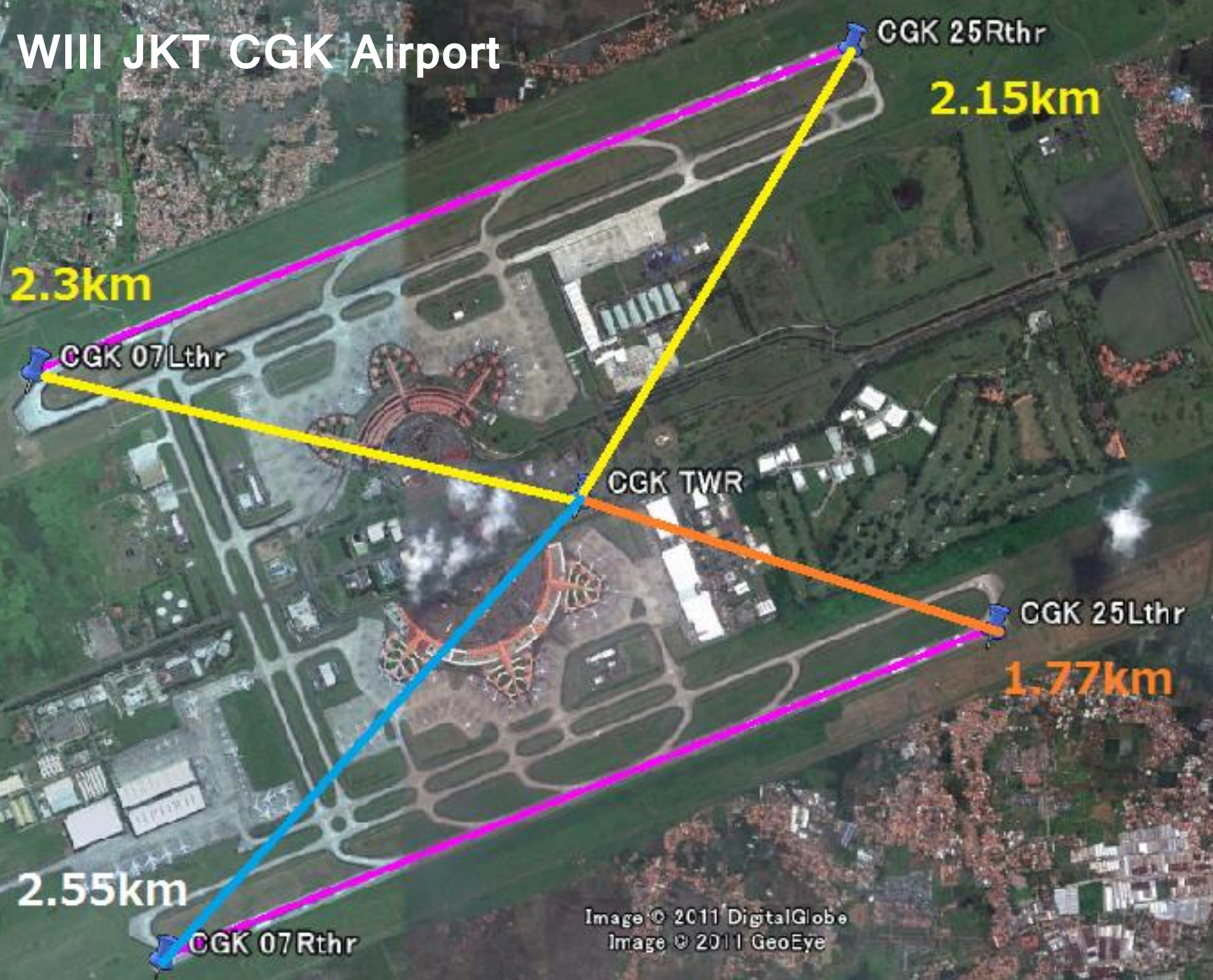
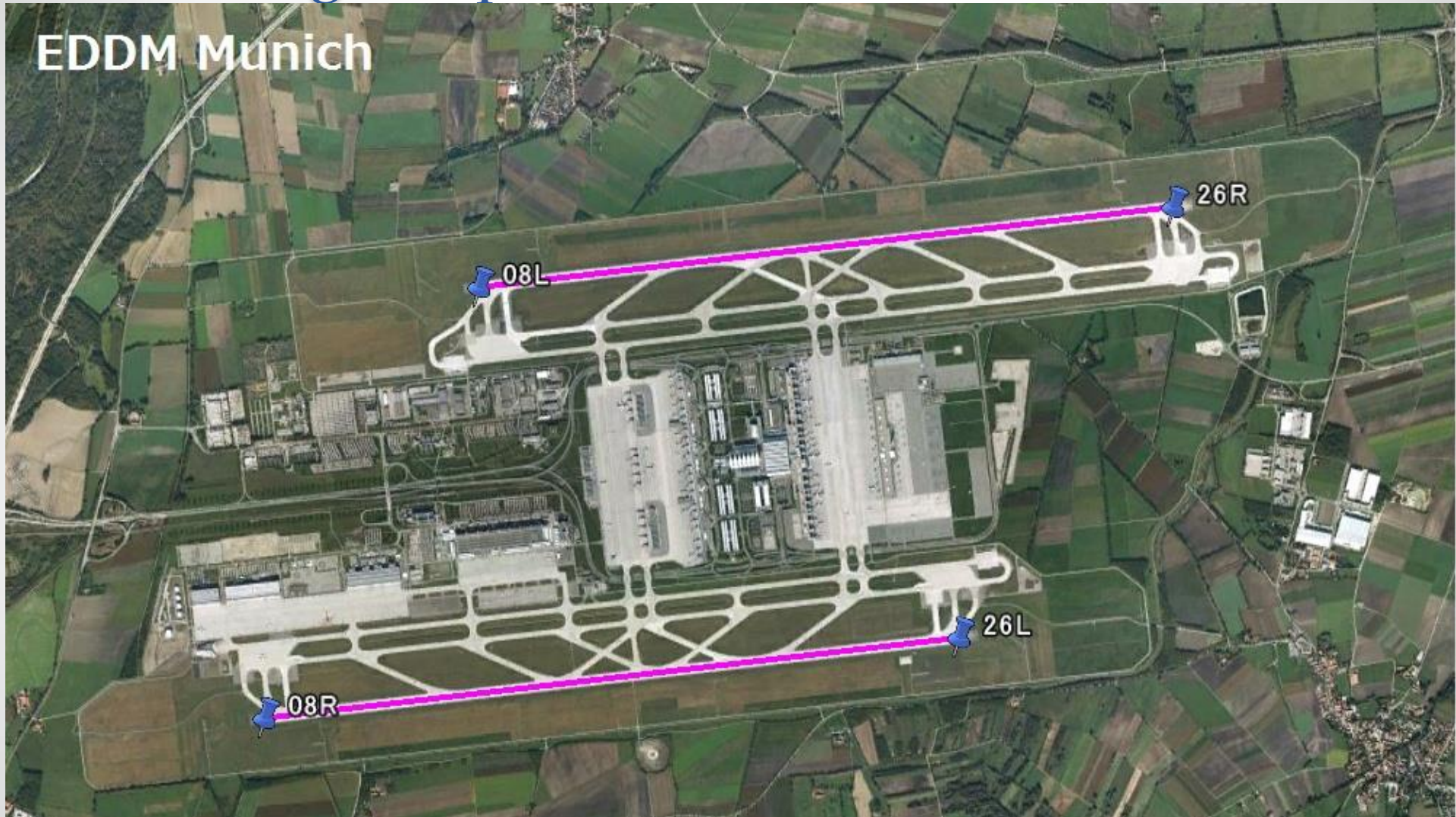


Image © 2011 DigitalGlobe
Image © 2011 GeoEye

Good design airport : EDDM MUC

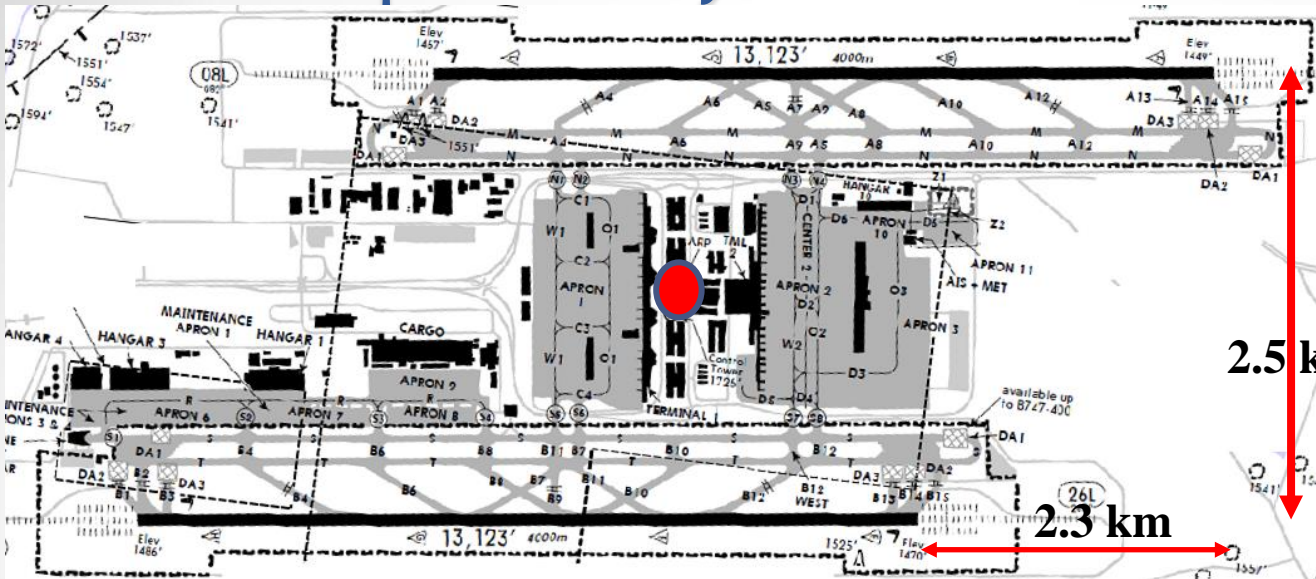
EDDM Munich



RWY08L/26R (13,123 x 197ft, 4,000 x 60m)

RWY08R/26L (13,123 x 197ft, 4,000 x 60m)

Comparison: Jakarta vs. Munich

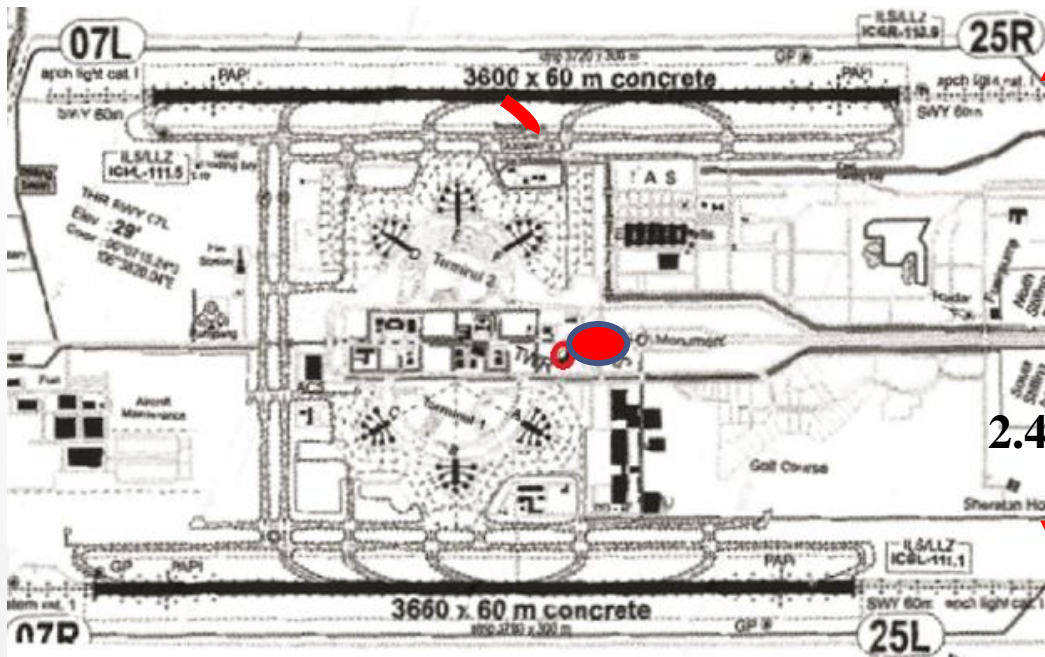


4000 x 60 meters

MUC

2.5 km

4000 x 60 meters



3600 x 60 meters

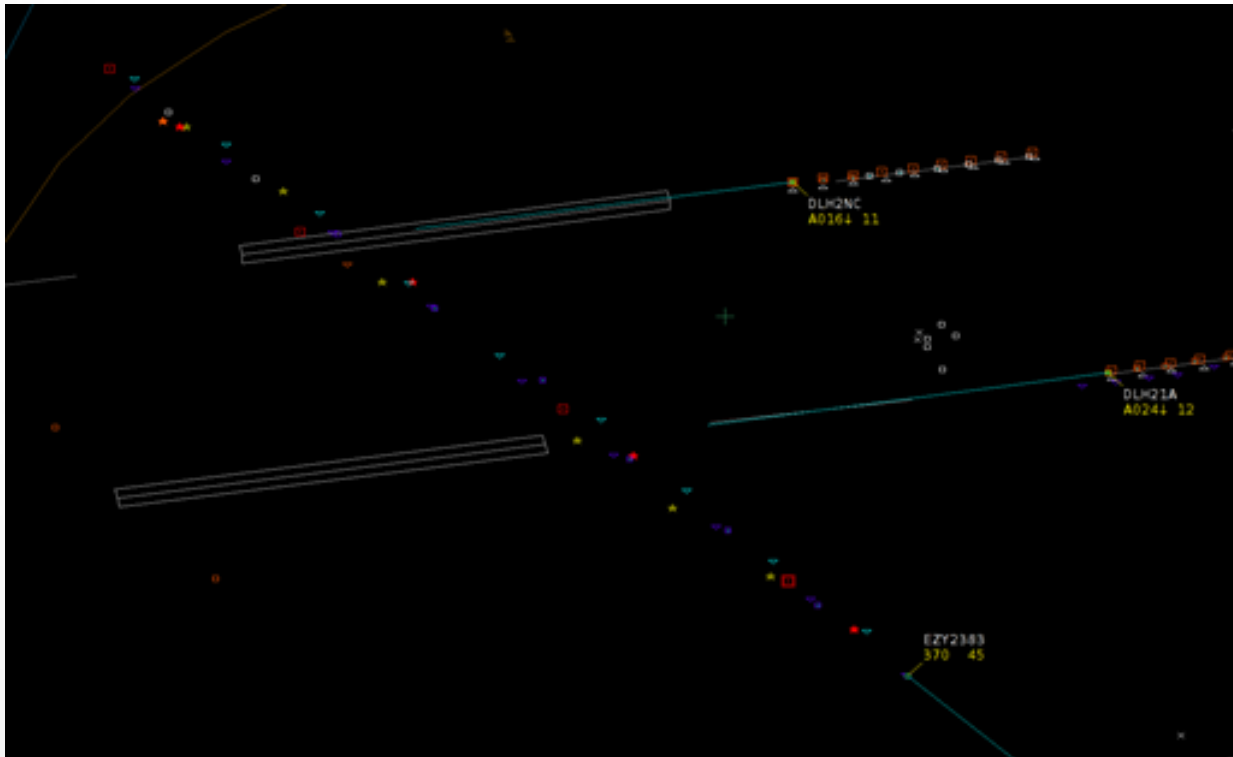
CGK

2.4 km

3660 x 60 meters

MUC ATC

- Equipped with Multiple ASR/SSR Mode-S
- Equipped with MLAT airport surface and airport vicinity surveillance system
- Equipped with multiple Nav aids



1 sec update rate

MLAT Controller's display

MUC airport layout



Landed aircraft can easily use first available high-speed exits and taxi via shortest routes

With some improvement

- **MUC ATC is capable to operate 90 movements an hour**
- **With some improvement, CGK will be able to show equal performance**
- **If we realize some Kaizen or improve existing condition**

Kaizen

(Improve)

Human Factors

in airport design

- Observe in relation with Humans
- Discuss the matter with Humans
- Study as a Human
- Standardize for Human performance
- Improve (Kaizen) to meet Human way
- Implement in a Human manner

Sample 1 : wrong data

- When I was looking into Indonesian AIP, I have noticed some error data:

Example1

AIP Vol 1 G 4.4-2

Sector A - from sea level to 37,000ft

Area contained within an arc of a circle 90 NM radius centred on SINJON (011324N 1035124E) from 013430N 1022353E anti-clockwise to Equator 1044330E, thence a straight line to Equator 1050340E, 002404N 1044807E, 005805N 1051200E, 012921N 1043441E, 011800N 1043000E, 011500N 1040000E, 010800N 1034500E, 011046N 1034015E, 011200N 1033900E, 011410N 1033137E, 011300N 1033000E, 013430N 1022353E.

SN N1 13 21.48 E103 51 14.46

N01° 13' 21.34" E103° 51' 15.22"

N1.222594 E103.854228

Sample 2 : wrong location

Example 2

		125.45	H - 24	Arrival East (AE)
TWR	SOEKARNO - HATTA Tower	118.2 118.75	H - 24 H - 24	TWR coordinate : <u>06 07 38.21 S</u> <u>106 39 38.57 E</u>
SMC	SOEKARNO - HATTA Ground 1 SOEKARNO - HATTA Ground 2	121.60 121.75	H - 24 H - 24	



Sample 3 : wrong WGS-84 data

Example 3



Sample 4 : WGS-84 data

Example 4

The location of Merpati PK-NVC crash as reported by NTSC was:

“The location $04^{\circ} 42'.25''$ S, $140^{\circ} 36'.84''$ E was approximately 2.8 Nm from District Abmisibil, the nearest district, or about 6 Nm from Oksibil.”

Aircraft Accident Report (KNKT.09.08.21.04)

Sample 5 : WGS-84 data

Example 5

The accident site was about 800 meters south west of the beginning of runway 01 or 550 meters from the coastline. The position of main wreckage is Latitude 03° 39' 8" S; Longitude 133° 41' 15" E.

1.10 AERODROME INFORMATION

Aerodrome Code	:	WASK / KNG
Airport Name	:	Utarom Airport
Airport Address	:	Jl. Utarom Kaimana PO. Box 10 Kaimana, Papua Barat 98654
Airport Class	:	III
Airport Authority	:	DGCA
Airport Service	:	AFIS
Type of Traffic Permitted	:	VFR
Coordinates	:	<u>03° 38' 00" S, 133° 41' 00" E</u>

**So, the destination airport is
West side of the crash site...**

**But, actually it crashed on
West side of the coast onto
the sea.**

KNKT.11.05.10.04

Practical Human Factors Implementation

- **Although they seem only minor errors, in the realm of new CNS/ATM, Maps, Charts, Procedures are based on the accurate numbers and figures. They mean a lot.**
- **If some one made a mistake, and some other found it, it is good practice to report it for correction as an action of CRM, in the broad sense of Human Factors.**
- **This a fundamental and basic implementation of Safety Management System.**
- **If all of us in the Indonesian aviation system, try to find any discrepancy or unsafe data and report, we can eliminate them at once. Let's act now and make Indonesian Sky a safe one.**

Brighten your corner