



## Safety Investigation Report

# RUNWAY INCURSIONS AT BRUSSELS AIRPORT - EBBR

Ref. AAIU-2014-EBBR-RI  
Issue date: 22 August 2014  
Status: Final

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## 1 Introduction

Between January 2014 and March 2014 five similar runway incursions occurred at Brussels International Airport (EBBR).

Runway incursions are generally considered a high risk concern on airports. The 1977 Tenerife airport disaster, the deadliest accident in aviation history, was the result of a runway incursion.

As the prevention of runway incursions is one of the key operational measures of the 2010-2014 Belgian Safety Plan of the Belgian Civil Aviation Authority (BCAA), the Air Accident Investigation Unit of Belgium (AAIU(Be)) decided to perform a limited scope safety study in order to determine whether safety actions are needed.

### 1.1 European Action Plan for the Prevention of Runway Incursions

A European Action Plan for the Prevention of Runway Incursions (EAPPRI) was established in 2003 and was further revised and enhanced in 2011. The plan contains several recommendations to different stakeholders. The recommendations are divided into:

- General principles
- Aerodrome operator issues
- Communications
- Aircraft operator issues
- Air navigation service provider issues
- Data collection and lesson sharing
- Regulatory issues
- Aeronautical information management

In Appendix D of the EAPPRI, the term 'sterile flight deck' is introduced. This is defined as any period of time when the flight crew should not be disturbed, except for matters critical to the safe operation of the aircraft. It is strongly advised to adopt the sterile flight deck concept whilst taxiing.

### 1.2 Definition of runway incursion

To enable the sharing of safety lessons learned and a common understanding of runway incursion causal and contributory factors ICAO introduced a commonly agreed definition of a runway incursion in November 2004. The definition is:

"Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft."

The protected area is a clearly defined zone indicated by, amongst others, signs and ground markings.

### 1.3 Classification of the severity of runway incursions

For the purpose of risk measurement, ICAO Doc 9870, Manual on the Prevention of Runway Incursions, defines 5 severity categories:

- A A serious incident in which a collision is narrowly avoided.
- B An incident in which separation decreases and there is significant potential for collision, which may result in a time-critical corrective/evasive response to avoid a collision.
- C An incident characterized by ample time and/or distance to avoid collision.
- D An incident that meets the definition of runway incursion such as the incorrect presence of a single vehicle, person or aircraft on the protected area of a surface designated for the landing and take-off of aircraft but with no immediate safety consequences.
- E Insufficient information or inconclusive or conflicting evidence precludes a severity assessment.

## 2 Factual information

### 2.1 History of incursions

*22 January 2014 17:52 UTC*

Turkish Airlines flight TH3MG from EBBR to LTBA holding at TWY B1 was cleared for take-off on RWY 25R but turned right on RWY 19 and initiated take-off. Take-off was cancelled by air traffic control.

Total FH captain: 5534  
Total FH F/O: 1114

Severity category: D

*25 January 2014 07:15 UTC*

Turkish Airlines flight THY3MH from EBBR to LBTA attempted take-off from non-active RWY 19 while there was just before a landing on RWY 25R and TH3MH was cleared for line-up on RWY 25R. Take-off was cancelled by air traffic control.

Total FH captain: 17535  
Total FH F/O: 1687

Severity category: D

*17 February 2014 14:35 UTC*

Turkish Airlines flight THY4KJ from EBBR to LBTA was cleared for line-up RWY 25R but instead lined-up on RWY 19 from position B1. Take-off was cancelled by air traffic control.

Total FH captain: 5095  
Total FH F/O: 1804

Severity category: D

*9 March 2014 08:45 UTC*

EasyJet flight EZY2796 from EBBR to Milano Malpensa Airport (LIMC) was taxiing to RWY 25R via TWY B1. After line-up clearance the aircraft made an initial turn towards RWY 19 (which was not in use). At the same time the crew agreed they were entering the wrong runway, air traffic control prompted about the right direction for the take-off runway. The aircraft lined up for RWY 25R and took off.

Total FH captain: 5500  
Total FH F/O: 6700

Severity category: D

22 March 2014 14:07 UTC

EgyptAir flight MSR726 from EBBR to Cairo International Airport (HECA) received take-off clearance for RWY 25R when he was on TWY B1. He turned to the right towards RWY 19 instead of to the left towards RWY 25R. The air traffic control instructed him to stop immediately.

Total FH captain: 5242  
Total FH F/O: 3655

Severity category: D

Note:

All of the above mentioned occurrences are related to turn to and enter on the wrong runway. Besides these incursions there were many occurrences involving aircraft turning towards the correct runway but making their turn to wide, and therefore enter the protected area of the other runway.

## 2.2 Feedback from operators

The common feedback was that most flight crew involved were not very familiar with the airport. ATC instructions were deemed clear but the charts used could be better. At the time of the incidents all flight crew used paper charts from navigational information service providers. EasyJet and EgyptAir were using Jeppesen chart, Turkish Airlines was using Lido chart.

The operators commented also that the runway entry gives rise to confusion.

## 2.3 Meteorological conditions

All incursions occurred during daytime. The visibility was ok; the runway visual range (RVR)<sup>1</sup> was more than 800m.

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<sup>1</sup> Runway visual range (RVR): The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

## 2.4 Communication

All traffic control is done by Belgocontrol, an autonomous public company in charge of the safety of air traffic in the civil airspace for which the Belgian State is responsible. The take-off clearances are given by 'Brussels Tower', which has multiple frequencies, assigned to the flight crew by 'Brussels Ground'.

The clearances and read backs in all concerned occurrences were done using ICAO standard phraseology and plain English in compliance with ICAO Doc 4444, Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM).

## 2.5 Aerodrome information.

### 2.5.1 General information

Brussels airport is located at 6.5 Nautical Miles (12km) NE of the city of Brussels, on the coordinates 50°54'05"N 004°29'04 "E. The elevation is 56m ASL.

The airport is certified (certificate N° A-POR\2012\Annex14\_001) to be compliant with the requirements of ICAO Annex 14 and the Belgian Law (AR/KB 15 March 1954).

The airport has three bi-directional runways (01/19, 07L/25R and 07R/25L with hardened asphalt. All three runways are certified to ICAO reference code "4E" (this code interrelates the numerous specifications concerning the characteristics of aerodromes, including the length of runways and the size of aircraft it can accommodate).

Due to the shift of the magnetic north, the name of runway 01/19 has been changed on 19 September 2013. Previously its name was 02/20.

RWY 25R and RWY 19 are intersecting runways in a V-shaped configuration. This is a geometry where two runway ends commence from the same location but proceed in different directions. There is one common taxiway B1 to enter both runways. This taxiway has two holding positions;

- An ILS Category (Cat) II/III holding position, which is active during low visibility conditions and located approximately 175m taxiing distance from the runway centrelines
- An ILS Cat I holding position, located approximately 110 m taxiing distance from the runway centrelines





Figure 1: Aerial view taken on 7 July 2013. Runway 20 has become runway 19 as from 19 September 2013





Figure 2: Holding point signs right-hand side at taxiway B1



Figure 3: Holding position signs and information signs left-hand side at taxiway B1

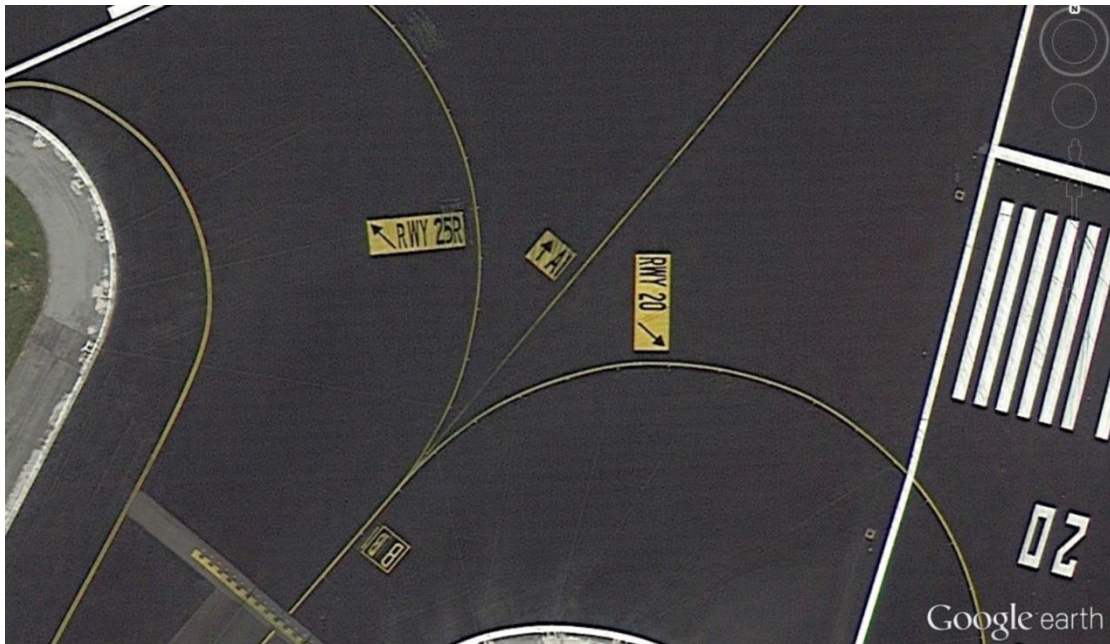


Figure 4: Zoom on the instruction markings at TWYB1

### 2.5.2 Local Runway Safety Team

The European Action Plan for the Prevention of Runway Incursions was released in 2003 as a product of the European Runway Safety Initiative (ERSI), which was an international effort with participants representing the full spectrum of stakeholders from the aviation community.

One of the recommendations contained in this action plan was to establish a Local Runway Safety Team to lead action on local runway safety issues.

Following this recommendation a Local Runway Safety Team was launched at Brussels Airport that chiefly focuses on the prevention of runway incursions and safety issues to do with operations on the manoeuvring area. The Committee, which meets on a monthly basis, consists of members of Brussels Airport Company, Belgocontrol, Belgian Cockpit Association (which regroups airline pilots and flight engineers from Belgian airlines) and representatives of the home carriers. The BCAA participates as observer.



### 2.5.3 Hot spots

Brussels Airport has identified hot spots, further published on the special Aerodrome Ground Movement Chart (AGMC) in the Aeronautical Information Publication (AIP) Belgium and G.D. Of Luxembourg. The location where the concerned incursions happened was defined as a hot spot accompanied with following text:

*“B1, W41 and W42. Confusing runway entry. Make sure to line up on the correct runway”*

The ICAO definition of a hot spot is:

*“A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.”*

Typically it is a complex or confusing taxiway/taxiway or taxiway/runway intersection. The criteria used to establish and chart a hot spot are contained in the ICAO docs 9870 - Manual on the Prevention of Runway Incursions, 4444 - PAN S-ATM and Annex 4 - Aeronautical Charts. Hot spots should be identified and brought to the attention of the Local Runway Safety Team. Hazards associated with hot spots should be mitigated as soon as possible and as far as is reasonably practicable. Operational staff needs to be made aware of hot spots at aerodromes.

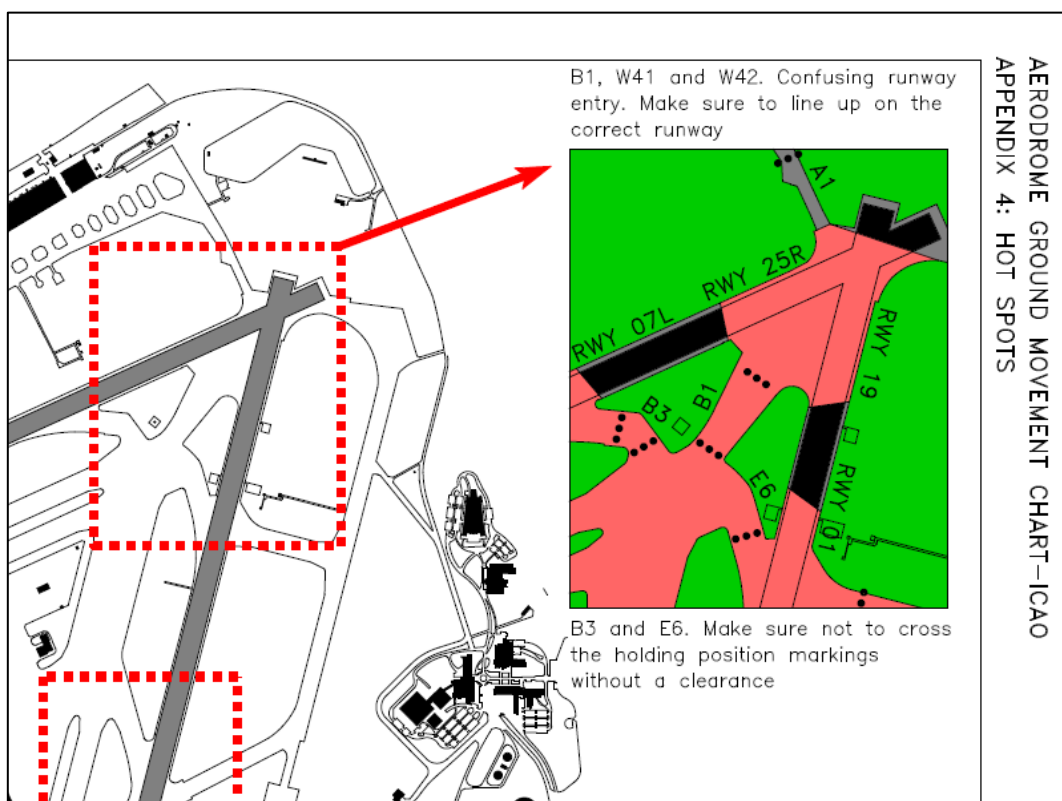


Figure 5: Zoom of AGMC chart, published in the AIP

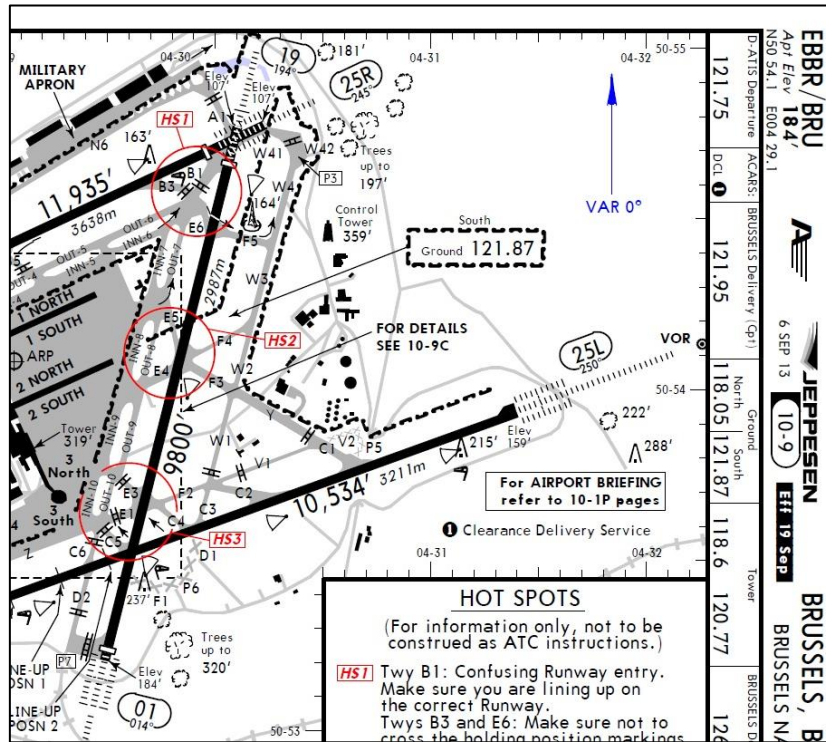


Figure 6: Hot spot indication on Jeppesen chart

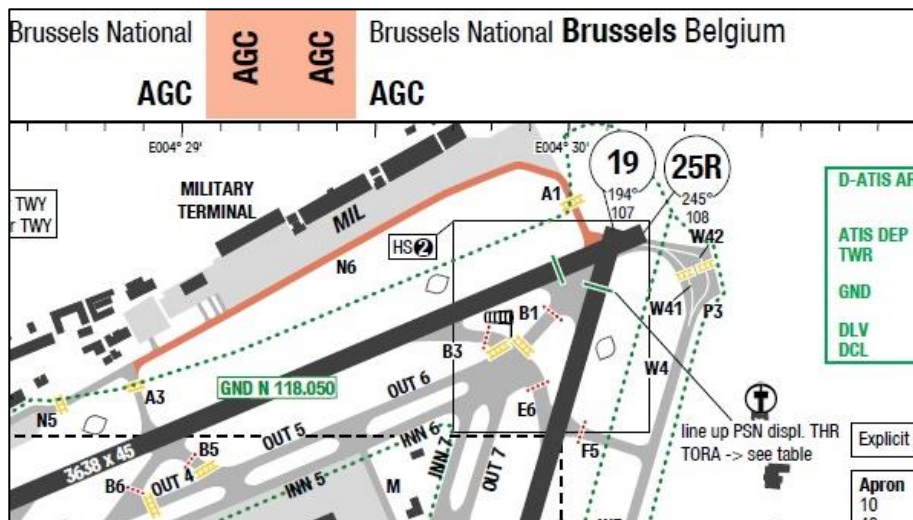


Figure 7: Zoom on hot spot indication on Lido chart (text is below on the map)

## 2.6 Occurrence reporting by Belgocontrol

The concerned incursions were all reported by Belgocontrol. In 2012 the total number of reported occurrences (thus not only runway incursions) in Belgium increased by 12% compared to 2011. As from April 2013, internal incident reporting procedures were simplified.

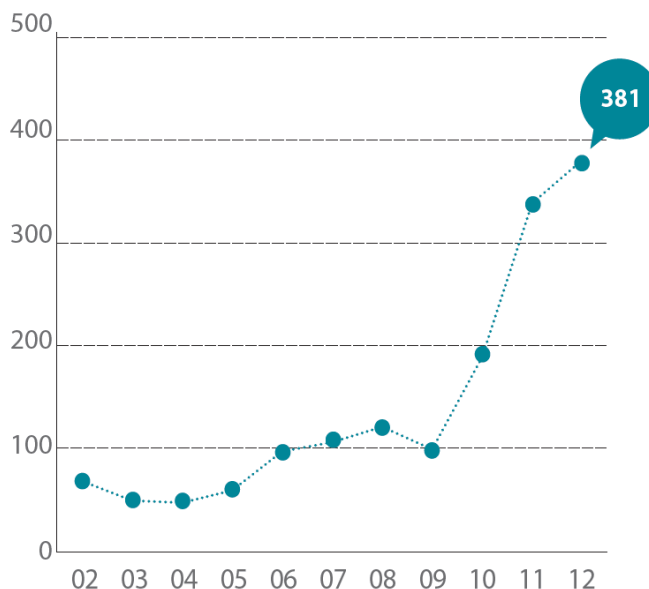


Figure 8: Evolution of number of all occurrences reported by AT controllers in Belgium

## 2.7 ICAO Annex 14

The international standards and recommended practices for aerodrome design and operations are contained in ICAO Annex 14.

Guidance for the use of mandatory and information signs and markings is described in chapter 5.

5.4.2.2 Mandatory instruction signs shall include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

5.4.3.2 Information signs shall include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

Taxiway minimum separation distances are explained in chapter 3

**3.9.8 Recommendation.** — *The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object should not be less than the appropriate dimension specified in Table 3-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*



### **3 Analysis**

#### **3.1 Number of occurrences**

Most of the runway incursion occurrences are reported by ATC (Belgocontrol). The number of all occurrence (not only runway incursion) reports has seriously increased over the last years, mostly further to an improvement in awareness for the need of reporting all incidents. Also as from April 2013, the Belgocontrol internal incident reporting procedures were simplified. This may explain the sudden rise of similar runway incursion reports at Brussels Airport.

Nevertheless all concerned incursions were classified in category D severity, and therefore were not an immediate serious safety concern. It is highly probable that such incursions happened before but were never reported.

#### **3.2 Weather**

Was not a factor in the concerned incursions.

#### **3.3 Phraseology and language**

Standard phraseology in plain English was used by both the flight crew and the air traffic controllers. Read backs were done when required by ICAO standard practices and corrective actions were made immediately when prompted by the air traffic controller. However, in four of the five concerned incursions, the aircraft turned right on RWY 19 instead of left on 25R. Turkish airlines and other companies commented that the instruction “runway 25 RIGHT cleared for take-off” might confuse pilots by thinking they heard the instruction to turn right. However both the used runway designation and phraseology are in accordance with ICAO standards. Adding other instructions is in contradiction with ICAO and might introduce other hazards.

#### **3.4 Visual aids**

All mandatory instructions signs and markings are in compliance with ICAO standard practices. On the left hand side of TWY B1, information signs give the direction of both runways 25R and 19.

Mandatory instruction (red boards) signs are located on both sides of the taxiway; they do not show arrows, only the reference of the runway. Information boards, are also located on both sides of the runway, and they do feature arrows.

Considering that crew are looking primarily to red boards they may discard valuable information – such as the arrows on the yellow (information) boards.

Logic might dictate that the red board should contain all adequate information, and in this case, the use of arrows to indicate the direction of the runway entry, might be adequate, however, the use of arrows on mandatory instruction signs is not in compliance with ICAO.

The European Aviation Safety Agency (EASA) also emphasizes on the standardisation of visual aids in their recently published Certification Specifications (CS) for Aerodrome Design, which is fully supported by the BCAA.

### 3.5 Flight crew

It emerged from the feedback from the operators that the fact that some crew members were not familiar with the airport lay-out was a contributing factor. This can explain the confusion when hearing “25 RIGHT” (see 3.3) although the active runway is also mentioned with the initial taxi instructions and not only when take-off clearance is given.

However the high workload (looking at the SID-charts, performing the necessary checklists) during taxiing might also play an important part in the problem. Taxiing is considered as a critical phase of flight justifying adoption of the sterile flight deck concept. Pilots should be “head-up” and cross checking each other as much as allowed within the necessary operation tasks.

### 3.6 Charts used

None of the flight crew involved in the 5 incidents used the official chart of the AIP to prepare the taxiing. However the hot spot was indicated on the charts that were used. Although the explanation was not written next to the hot spot, it could be found on the charts.

The indications of the runways on the Lido chart are not aligned with the centrelines and could contribute to the confusion.

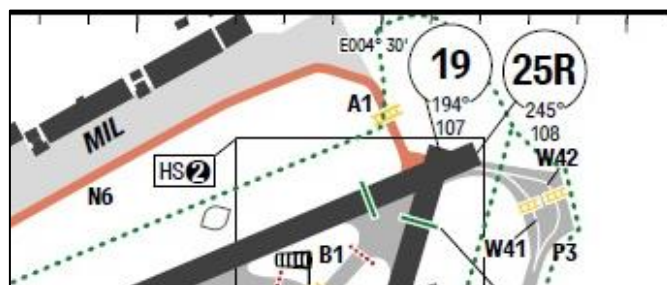


Figure 9: Runway indications on Lido chart

### 3.7 Aerodrome layout

There's no doubt that the layout of the runway entry where one taxiway leads to two runway ends is the root cause of the occurrences. ICAO Doc 9870 also mentions that an important factor in preventing runway incursions is to limit the physical possibility for pilots and vehicle drivers to mistakenly enter runways.

When splitting taxiway B1 into two individual taxiways leading respectively to runway 25R and runway 19 and each provided with stop bar lights at their holding position sign, then the physical possibility to enter the wrong runway will be excluded. As an example, Cairo International Airport has a similar taxiway design.

Besides, as the both taxiways will not be used at the same time, it may be permissible by ICAO Annex 14 to operate with lower separation distance of the centrelines if a study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

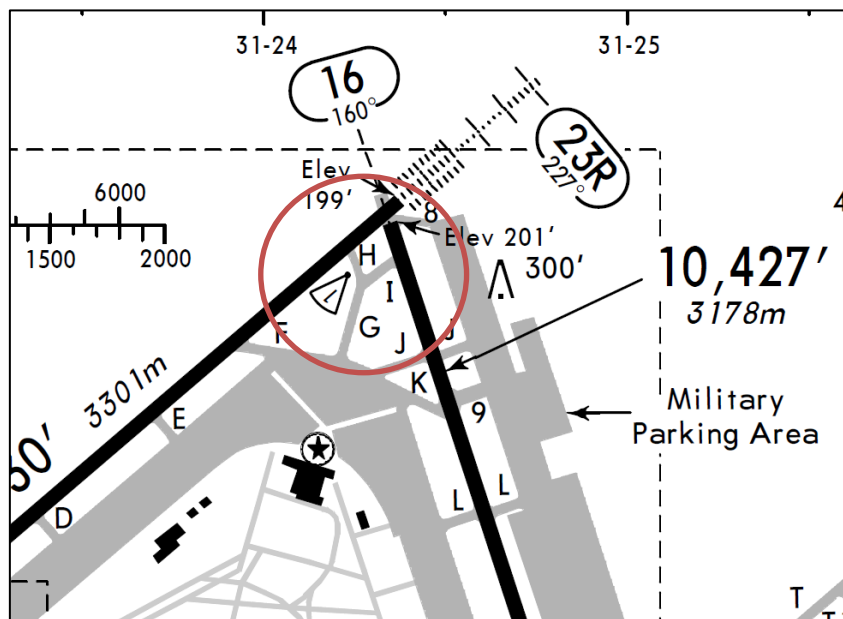


Figure 10: Taxiway design at Cairo as an example

#### 4 Conclusions

- Improved incident reporting system by Belgocontrol is a factor why there is a rise in reports of runway incursion incidents
- The reported incursions can be considered as minor incidents but revealed potential safety issues
- Visibility was not a factor
- The used phraseology was in accordance with ICAO standards but can have been a contributing factor by confusing pilots not familiar with the airport hearing '25 RIGHT',
- Air traffic control was not a factor
- Familiarisation of the flight crew was a contributing factor [safety issue]
- Workload in the cockpit during taxiing can be a contributing factor
- Used aeronautical charts were in some incidents a contributing factor
- Runway holding position signs are in accordance with ICAO Annex 14
- Aerodrome layout, with a single taxiway leading to V-shaped runways, was a contributing factor [safety issue]

There were a lot of positive factors which played an important role in reducing the risks and the outcomes associated with the reported occurrences (visibility, communication, actions of air traffic controllers,..). However some serious safety issues do exist and can be a root cause of serious incidents or even accidents if the positive factors (which are characteristics at a specific point in time) are not present. The Air Accident Investigation Unit of Belgium is in the opinion that these safety issues need to be addressed.

## **5 Safety actions and recommendations**

### **5.1 Safety issue: familiarisation flight crew**

#### **Action taken by Brussels Airport LRST and Turkish Airlines**

Both the LRST and Turkish Airlines advised Lido to improve their ground movement chart by aligning the runway numbers with the centrelines of the runways.

#### **Safety action taken by Turkish Airlines**

As Turkish Airlines was the company involved in 3 of the 5 occurrences, they were asked by Belgocontrol to take corrective measures. They issued both a company safety note and company NOTAM circulated among the flight crew and putting emphasis on the hot spot.

#### **Safety recommendation 2014-C-5 to the Brussels Airport LRST**

AAIU(Be) recommends that the Brussels Airport Local Runway Safety Team holds the familiarisation of the airport as a key point on the agenda by making and circulating a safety information letter on this specific hot spot only. As this initiative groups representatives of airline pilots and home carriers this is the primary mean to sensitize all flight crew flying on Brussels Airport about the current situation.

### **5.2 Safety issue: aerodrome layout**

#### **Safety recommendation 2014-C-6 to Brussels Airport Company**

AAIU(Be) strongly recommends that the Brussels Airport Company undertakes a study to redesign and reconstruct the entry of the concerned runways by splitting the end of taxiway B1 into two individual taxiways, leading respectively to runway 25R and runway 19 and each provided with stop bar lights to clearly indicate the inactive runway. All this to mitigate both the risk that flight crew enter the wrong runway after having passed the holding position sign and the risk that flight crew enter the protected area of the other runway by making their entry turn to wide. This study should finally lead to a concrete proposal of redesign to the BCAA.