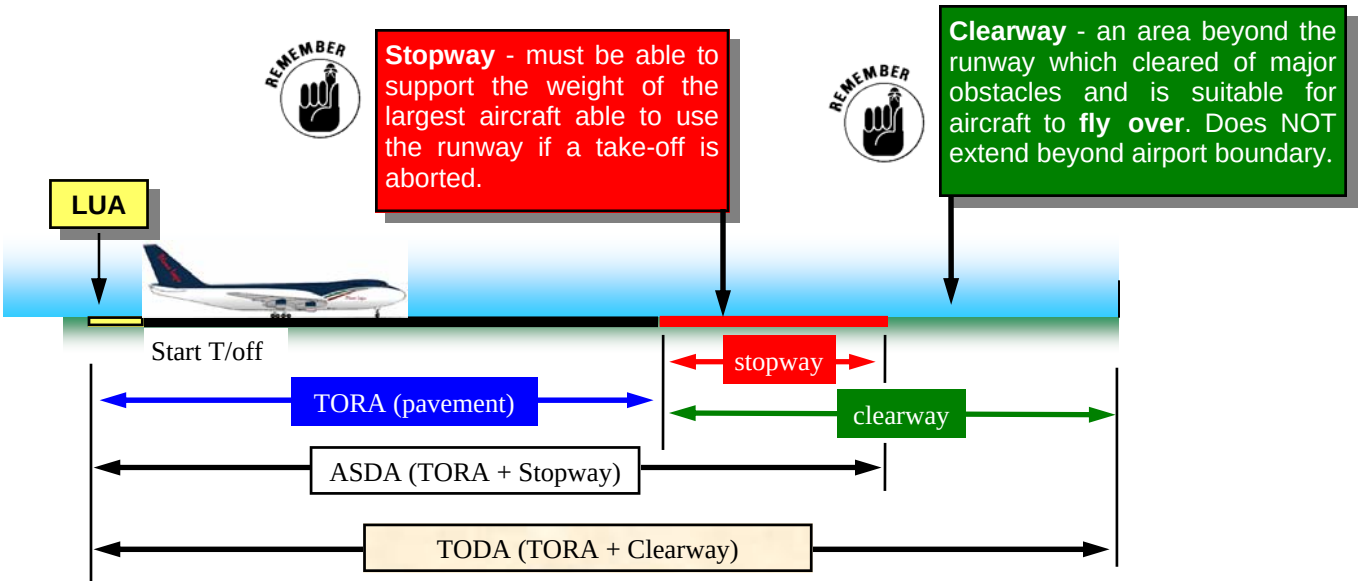
Module 1 - Takeoff Performance

Introduction

CAO 20.7.1b refers to turbojet or turboprop aircraft engaged in charter or RPT operations. With a few exceptions it assumes the loss of the critical engine at V1. Critical engine for a turbojet aircraft is the upwind engine in crosswind conditions. Understanding the various runway distances quoted in the ERSA is critical to understanding this CAO, and to passing the ATPL Performance examination. Another CAO of interest as background reading is CAO 101.4. This is available online at the CASA website (current legislation). These texts would be of most value if you reference both these CAO's.

Runway Definitions/Abbreviations (ref Fig 1.1)

- **TORA** is the physical length of the pavement (the black stuff). The aircraft must be airborne by the end of the TORA (obviously).
- **ASDA** is the length of the pavement, plus any stopway at the end of the runway. It is suitable for the ground run of an aircraft executing an interrupted takeoff (ie: ACCELERATE/STOP). The stopway does not need to be pavement, but some other hard surface that will "not cause significant damage to the aircraft structure". It must be able to support the weight of the aircraft (ie: not a swamp).
- **ASDR** is the accelerate/stop distance required by the aircraft assuming rejection of takeoff at V1. Takeoff weight shall be such that ASDR shall NOT exceed ASDA.
- **TODA** is the length of the runway, plus any clearway (that includes the stopway) at the end of the runway. The aircraft takeoff weight shall be such that it will reach at least 35 ft agl by the end of the clearway, following the failure of the critical engine at V1, unless the all engines operating case is more critical.
- **TODR** is the distance required for the aircraft to reach 35 ft agl following the failure of the critical engine at V1, unless the all engines operating case is more critical.
- **STOD** is the length of the runway available for the ACCELERATE/GO from V1, taking into consideration any obstacles which lie off the end of the runway. This may reduce the available length so that some of the runway must be considered unusable. Refer Fig 1.1.



Perins 1.

Fig 1.1. Runway geometry

Effective Operational Length (EOL)

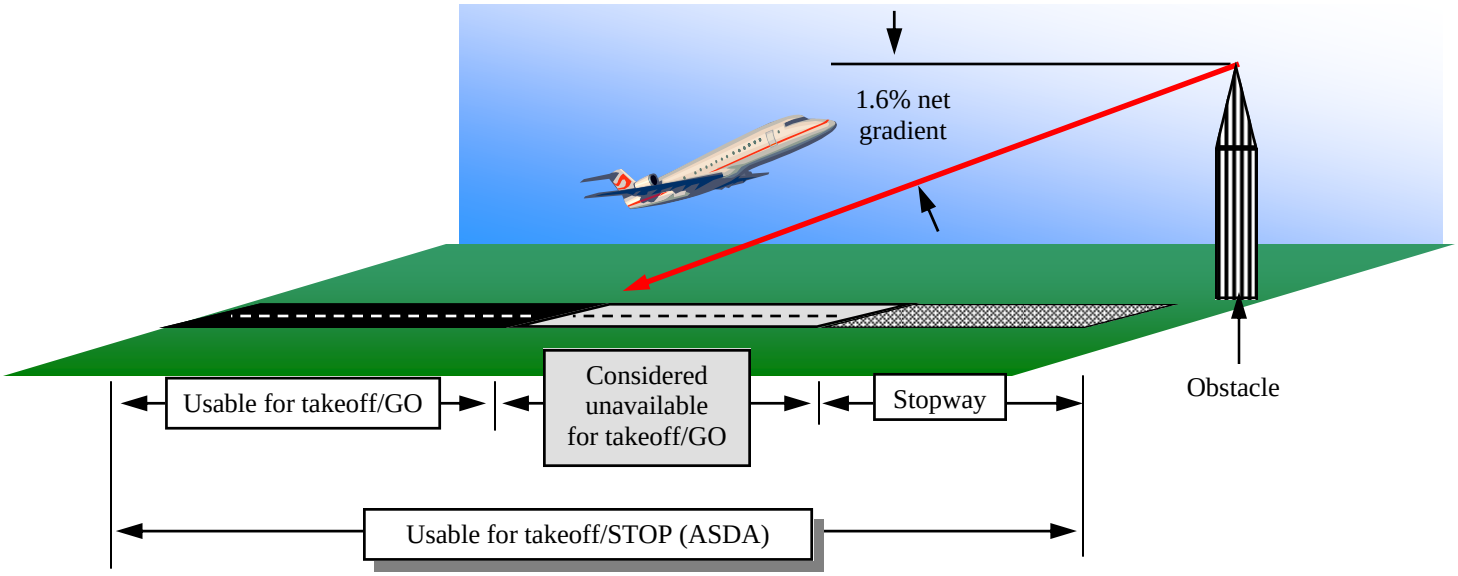
This is the actual length you will enter the takeoff graph with when finding the maximum takeoff weight possible given that the takeoff may be continued or rejected at V1 (decision speed).

First the worst case of the two is found (ie: worst of ACCELERATE/STOP, or ACCELERATE/GO).
In doing this you assess three distances. They are:

1 TODA ... being the ACCELERATE/GO scenario from V1.
2 ASDA ... being the ACCELERATE/STOP scenario from V1.
3 STOD ... being the ACCELERATE/GO scenario if an obstacle such as a building, radio mast reduces the runway to less than TODA (more on this soon).

Once the greater distance to STOP or GO is found, it is reduced by an amount required to turn the aircraft around 180 degrees after backtracking for takeoff. This distance is called the Line Up Allowance (LUA), and it varies according to aircraft model. A B727 for instance has a LUA of 45 metres, whereas a B747 may be more, and a Fokker 50 something less. The LUA is found in the aircraft manual. Basically, the only runway distance of use to you is that in front of you once you are lined up, ready for takeoff.

What we have then is a worst possible case situation that we assess the maximum allowable takeoff weight on. The V speeds such as V1, Vr, and V2 are then found using this maximum takeoff weight , unless a takeoff is made at a weight less than the maximum for this runway.



RWY Perf fig 1.2. A runway that is STOD limited for twin engine aircraft.

Effective operational length (EOL) is the lesser of TODA, ASDA, and STOD (if applicable), less the aircraft line up allowance (LUA). The runway with the longest EOL is the “Primary Runway”.

STOD (refer to fig 1.2)

This is the Supplementary Takeoff Distance, and it is found in the ERSA runway distances supplement (RDS). STOD ‘may’ restrict the TORA (but NEVER ASDA) to something less than the runways apparent physical length. The TAKEOFF/GO climb gradient performance after an engine failure at or after V1 will be less than with all engines operating, and may bring us too close to obstacles off the end of the runway. Such obstacles are surveyed for height, and then an imaginary gradient plane is worked off this, down toward the runway. If it strikes the runway within the TORA, the runway must be considered as only as long as the distance from the start of the takeoff roll to the point where the STOD plane meets the runway. Any runway beyond this must be considered unusable for the TAKEOFF/GO case.

It should be remembered that a runway length be limited by STOD only effects the TAKEOFF/GO case, NOT the TAKEOFF/STOP case. (ie: ASDA is NOT reduced by a STOD limit).

NOT all runways have obstacles of significance off the end of them, while those that do might only effect twin engine aircraft who's climb ability with one engine failed will be less than for those of better performing three or four engine aircraft types. So a runway may be STOD limited for twin engine aircraft, but not for three and four engine types. If no STOD limit is published for your aircraft engine configuration type, then it will NOT restrict the available TORA, and may be disregarded.

In Summary
Remember the runway is only as long as it's most limiting dimension, and all performance numbers and aircraft takeoff weight is based on the most limiting runway dimension.

Now attempt RWY Performance assignment 1.