



# **EAC**

## **No. 139-42**

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**Table Of Contents**

<b><u><a href="#">EAC139-42</a></u></b>	<b>CLEARWAYS AND STOPWAYS</b>
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## **CLEARWAYS AND STOPWAYS**

1 The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective aeroplanes. The runway, stopway and clearway lengths to be provided are determined by the aeroplane takeoff performance, but a check should also be made of the landing distance required by the aeroplanes using the runway to ensure that adequate runway length is provided for landing. The length of a clearway, however, cannot exceed half the length of take-off run available.

2 The aeroplane performance operating limitations require a length which is enough to ensure that the aeroplane can, after starting a take-off, either be brought safely to a stop or complete the take-off safely. For the purpose of discussion it is supposed that the runway, stopway and clearway lengths provided at the aerodrome are only just adequate for the aeroplane requiring the longest take-off and accelerate-stop distances, taking into account its take-off mass, runway characteristics and ambient atmospheric conditions. Under these circumstances there is, for each take-off, a speed, called the decision speed; below this speed, the take-off must be abandoned if an engine fails, while above it the take-off must be completed. A very long take-off run and take-off distance would be required to complete a take-off when an engine fails before the decision speed is reached, because of the insufficient speed and the reduced power available. There would be no difficulty in stopping in the remaining accelerate stop distance available provided action is taken immediately. In these circumstances the correct course of action would be to abandon the take-off.

On the other hand, if an engine fails after the decision speed is reached, the aeroplane will have sufficient speed and power available to complete the take-off safely in the remaining takeoff distance available. However, because of the high speed, there would be difficulty in stopping the aeroplane in the remaining accelerate-stop distance available.

3 The decision speed is not a fixed speed for any aeroplane, but can be selected by the pilot within limits to suit the accelerate-stop and take-off distance available, aeroplane take-off mass, runway characteristics, and ambient atmospheric conditions at the aerodrome. Normally, a higher decision speed is selected as the accelerate-stop distance available increases.

4 A variety of combinations of accelerate-stop distances required and take-off distances required can be obtained to accommodate a particular aeroplane, taking into account the aeroplane take-off mass, runway characteristics, and ambient atmospheric conditions. Each combination requires its particular length of take-off run.

5 The most familiar case is where the decision speed is such that the take-off distance required is equal to the accelerate-stop distance required; this value is known as the balanced field length. Where stopway and clearway are not provided, these distances are both equal to the runway length. However, if landing distance is for the moment ignored, runway is not essential for the whole of the balanced field length, as the take-off run required is, of course, less than the balanced field length. The balanced field length can, therefore, be provided by a runway supplemented by an equal length of clearway and stopway, instead of wholly as a runway. If the runway is used for take-off in both directions, an equal length of clearway and stopway has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater over-all length.

6 In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) should be equal to the accelerate-stop distance required or the take-off run

required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.

7 The minimum runway length and the maximum stopway or clearway length to be provided may be determined as follows, from the data in the aeroplane flight manual for the aeroplane considered to be critical from the viewpoint of runway length requirements:

- (a) If a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway must also be provided;
- (b) If a stopway is not to be provided, the runway length is the landing distance required, or if it is greater, the accelerate-stop distance required, which corresponds to the lowest practical value of the decision speed. The excess of the take-off distance required over the runway length may be provided as clearway, usually at each end of the runway.

8 In addition to the above consideration, the concept of clearways in certain circumstances can be applied to a situation where the take-off distance required for all engines operating exceeds that required for the engine failure case.

9 The economy of a stopway can be entirely lost if, after each usage, it must be regraded and compacted. Therefore, it should be designed to withstand at least a certain number of loadings of the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.