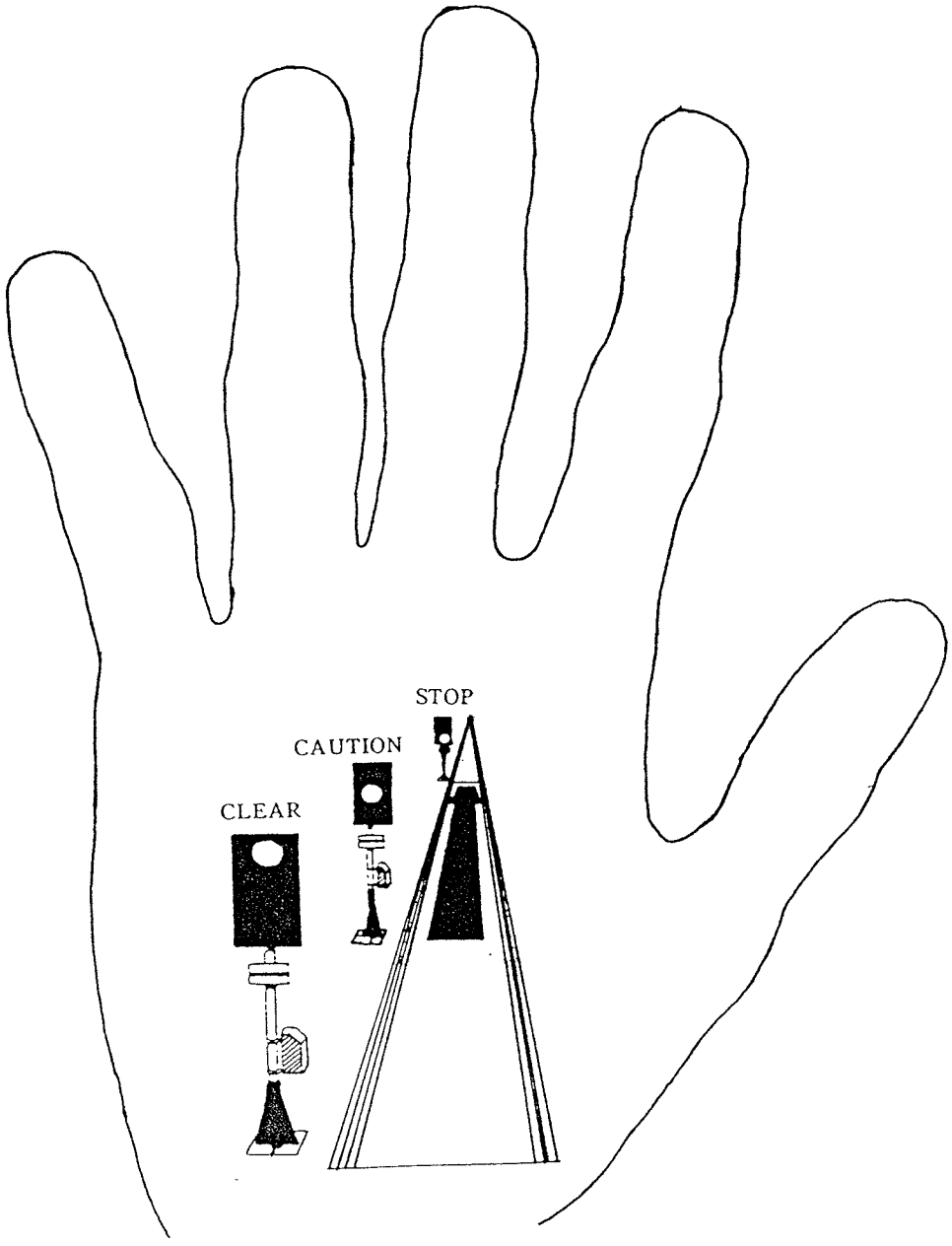
DIRECTOR OF S & T ENGINEERING.
WEST MIDLANDS PROJECTS GROUP.

INTRODUCTION TO "SERVICE BRAKING DISTANCE"



Introduction

In controlling train movements, signals are used for a number of purposes. Firstly they maintain a safe distance between two trains running in the same direction. Secondly they afford protection to trains at converging junctions and where there are conflicting movements. Thirdly they give directional indications at diverging junctions.

Present day signals are in the form of colour light indications and it is possible to arrange signals so that a succession of trains can run at close intervals without suffering delays yet satisfying the above requirements.

The Purpose of a Signalling System

The purpose of any signalling system is to pass information to the driver. This information can come in two forms. The most important is mandatory information which a driver has to obey and the second is advisory information which tells the driver of the state of the line ahead of him.

The first signals which were given to drivers were stop/go signals. The go signal telling the driver that the conditions were correct for him to proceed to the next signal. Communication between the two points established that the section or block was clear and thus a train was only allowed to enter a block section when it was free of trains.

As train speeds increased it was found that a train could not stop at a stop signal when sighting it at full speed. Thus to achieve the best result from the system it was necessary to provide warning or repeater signals for the stop signals. These signals were called distant signals and were placed sufficiently far enough away from the stop signals so that trains could stop in time at the stop signals. The distance between the the distant and stop signal is called the braking distance.

By providing such advanced warning signals, suitably placed, and provided drivers have confidence in the reliability and safety of the signalling system then drivers are able to exploit the potential of a line by travelling faster. Thus a signalling system not only ensures safety, but gives the driver such information that he is able to travel much faster.

continued

Braking Distance

The purposes of any warning signal is to give adequate warning for a train to stop at a stop signal. For any stop signal this means that its warning signal(s) has to be placed far enough back for any train travelling at its maximum allowable speed to be able to stop at that stop signal with the use of a normal braking application (see Fig 1). This distance is referred to as the Service Braking Distance and can vary with factors such as gradient, speed and braking characteristics of a train eg. vacuum brake, air brake, partially braked trains.

A full brake application in case of an emergency will bring a train to a stand in a much shorter distance but such a brake application is not desirable in normal service conditions.

It is found that the braking distance varies approximately with the square of the speed. There are other factors which are allowed for. These are:-

(a) Variations in weather conditions.

(b) Driver's reaction times to a warning.

(c) A driver's slight misjudgement of brake application.

(d) System reaction time to a brake application.
ie. how long it takes for the brakes to come on fully after a brake application.

(e) Variations in a standard braking system from train to train, eg, as a result of normal wear in the equipment.

continued

Two Aspect Signalling for general Railway use

When the braking distance increases because of higher train speeds, it is necessary to provide each stop signal with a warning or distant signal, placed at least at braking distance from the stop signal (see Fig 2). This is because there is insufficient distance to stop a train at a stop signal on sighting that signal at danger.

Three Aspect Signalling System

Very often conditions dictate that a stop signal and the warning signal for the next stop signal should be near or at the same place. They are then combined to give a signal capable of showing stop, caution and proceed, and a series of these signals gives a three aspect signalling system (see Fig 3). Each signal is then spaced at a minimum of braking distance from the next signal.

Four Aspect Signalling System

Under certain circumstances there is insufficient braking distance from a yellow aspect to a stop signal for a train running at full line speed. Under these circumstances a preliminary warning signal is introduced. This is the double yellow aspect which consists of two yellow lights displayed vertically.

The fourth aspect can also be used for a series of signals on a line giving a four aspect signalling system (see Fig 4). It will be seen that with this system the signal spacing can be halved, yet give adequate braking distance for full line speed. This system gives a greater track capacity and greater operating flexibility than a three aspect signalling system.

continued

INTRODUCTION TO "SERVICE BRAKING DISTANCE"

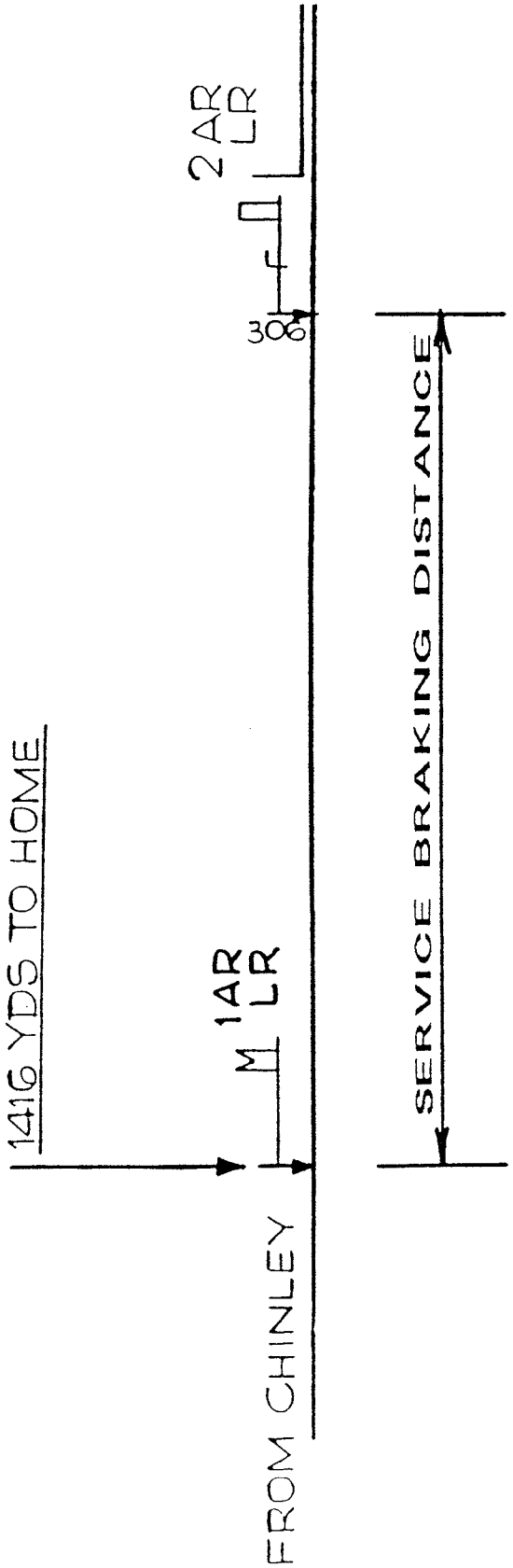


FIGURE 1. Service Braking Distance

continued

INTRODUCTION TO "SERVICE BRAKING DISTANCE"

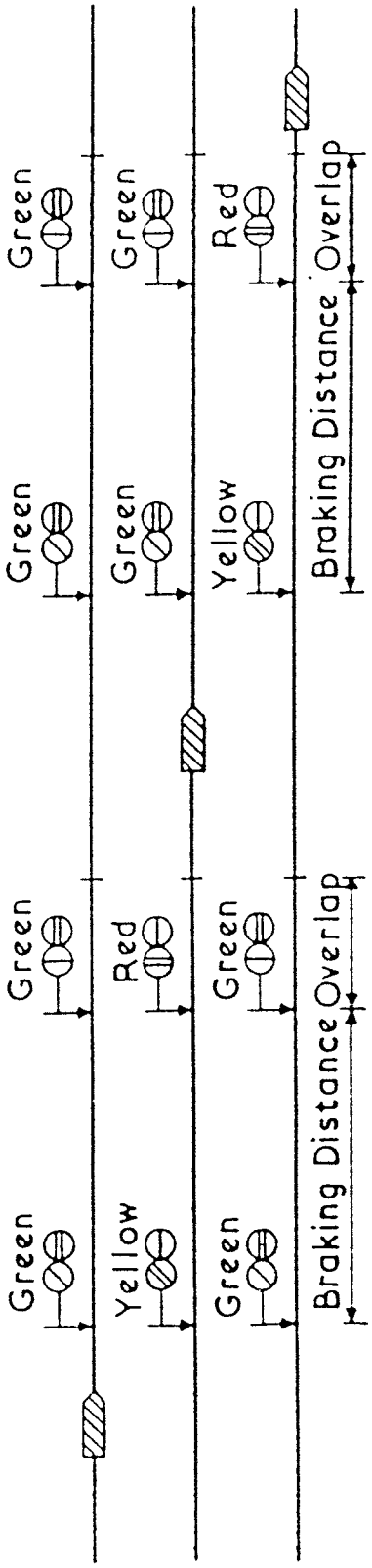


FIGURE 2. Two Aspect Signalling System

continued

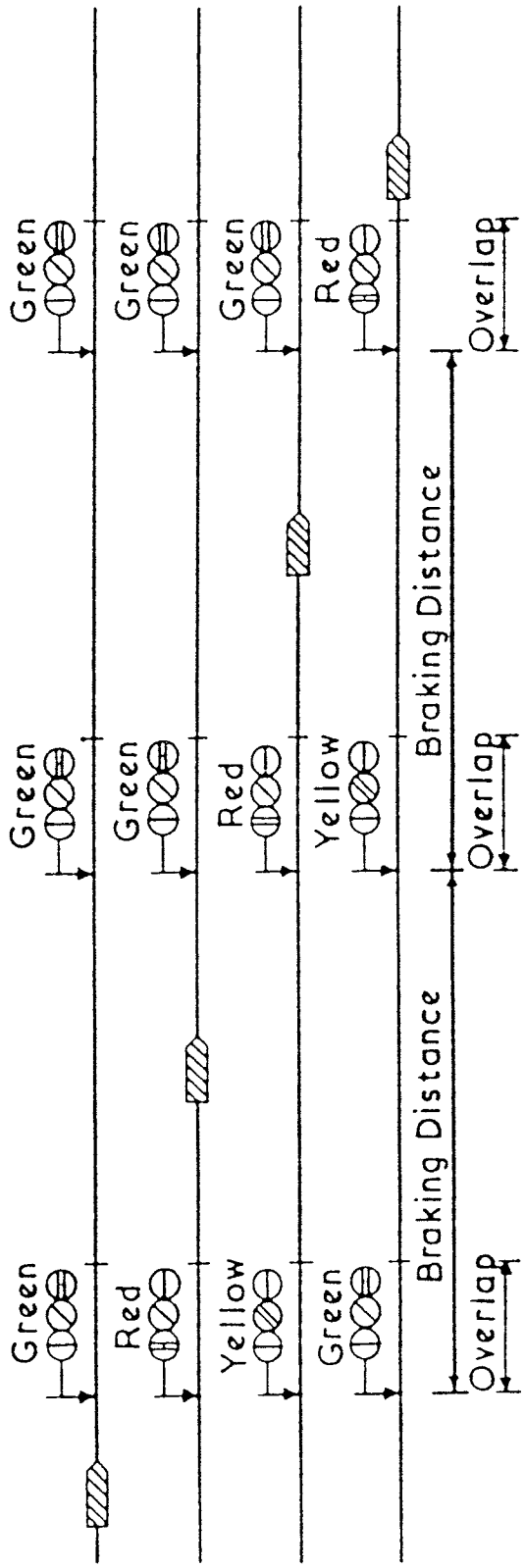


FIGURE 3. Three Aspect Signalling System

continued

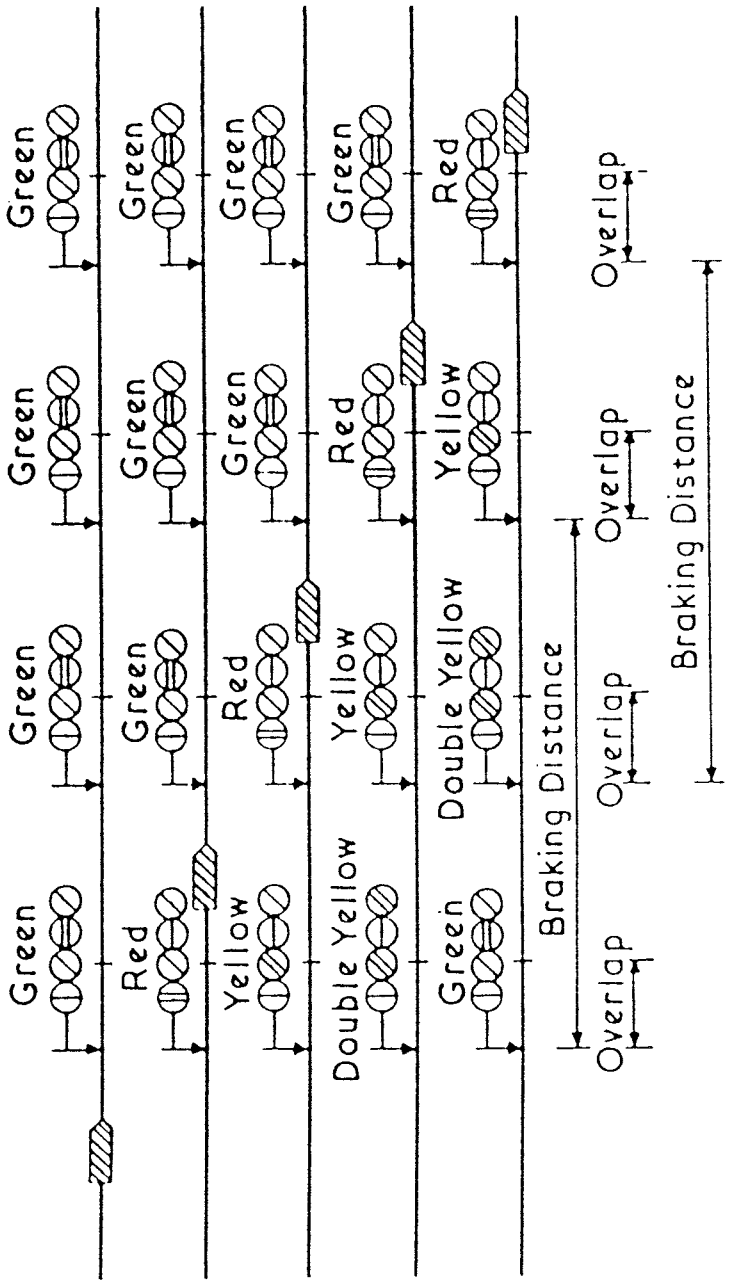


FIGURE 4. Four Aspect Signalling System

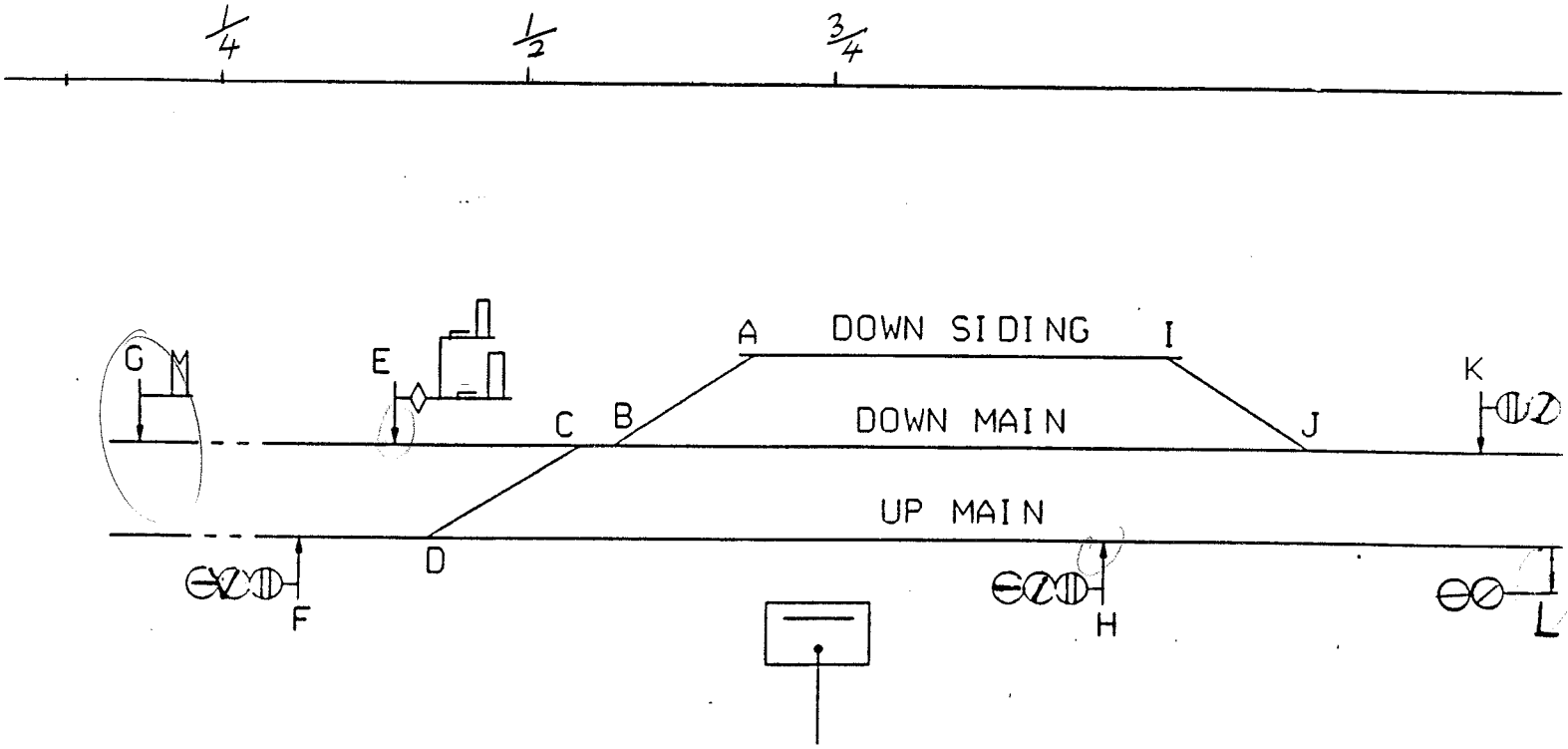
end

MODULE 10 QUESTION

SERVICE BRAKING DISTANCE (SBD)

Using the signalling plan illustrated information provided calculate the required service braking distance (SBD) of the Down Main Distant signal "G" and of the Up Main Distant signal "L".

The maximum speed of the line is 70 MPH.
Graph = Appendix B
The gradient throughout the area is 1 in 300 rising, from left to right.



1:10000

9 - 1250

L 1425-