



CHAPTER 2

Block

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Unit 3 Fixed Block Operation

- **Basic Rules of Fixed Block Operation**
- **Blocking Time and Headway Theory**

Introduction

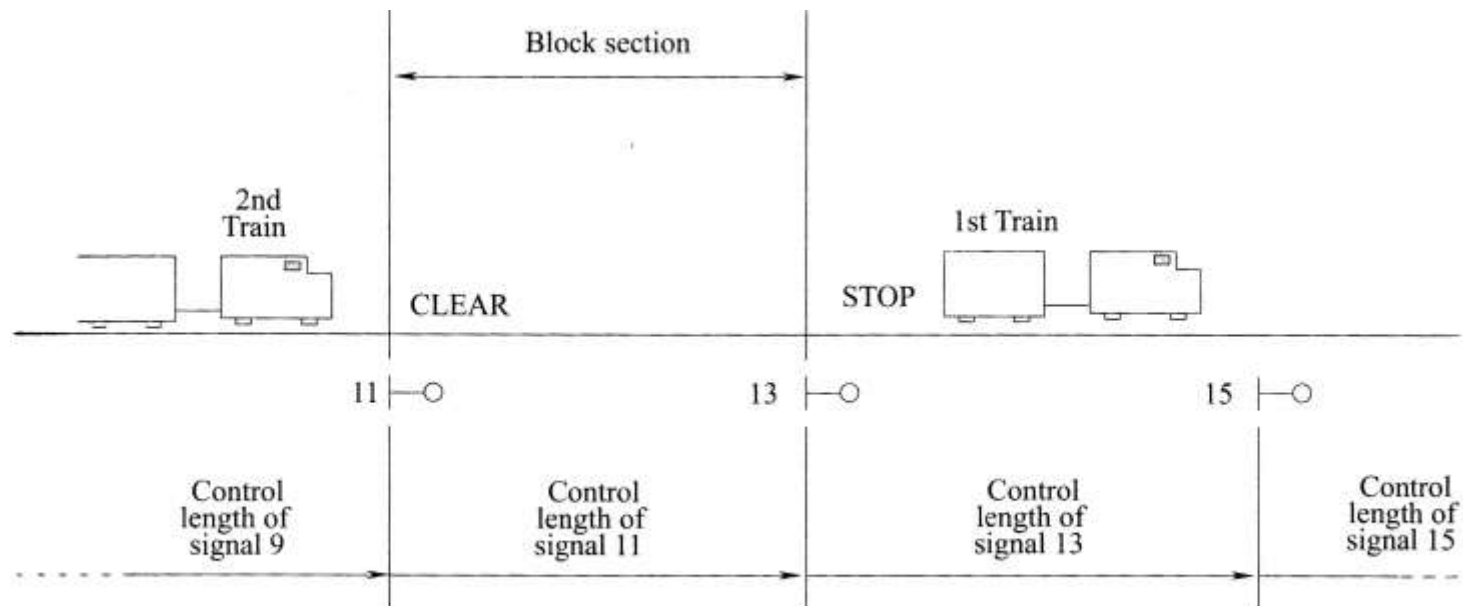
- Today, signal operations with a fixed block system is the most common form of operation.
- Signaling with lineside signals is still typical. But there is also an increasing use of **cab signal system**, especially on high speed lines where lineside signals cannot be watched safely.

3.1 Basic Rules of Fixed Block Operation

- A fixed block system is a block system using fixed block sections which are protected by signals (lineside or cab signals).
- To **clear a signal** for a train that is to enter a block section, the following conditions must have been **fulfilled**:
 - ◆ The train **ahead** must have cleared the block section.
 - ◆ The train ahead must have cleared the **overlap** behind the next signal (only on lines where block overlaps are used).
 - ◆ The train ahead must be protected from **following train** movements by a stop signal.
 - ◆ The train is protected against **opposing movements**.

3.1 Basic Rules of Fixed Block Operation

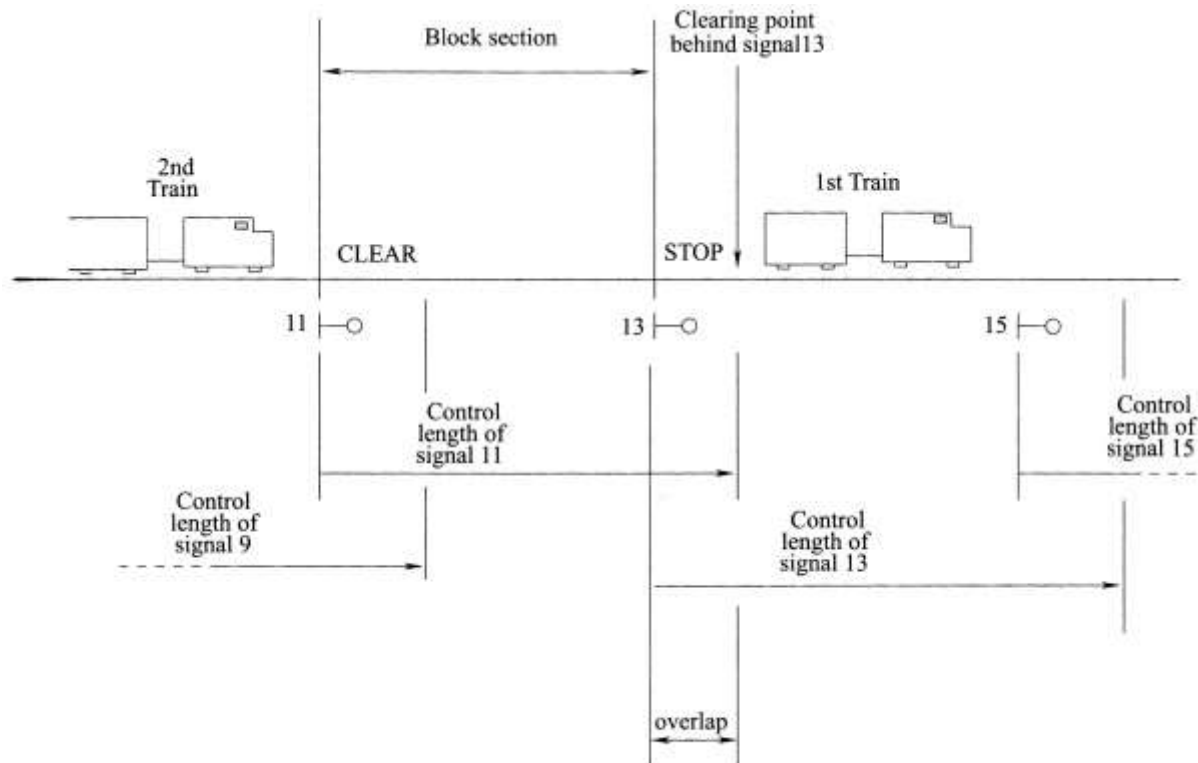
- On railways where **block overlaps are not required**, the control length of a signal equals the block section.
 - ◆ Examples are **mainline railway** in North America and in Russia.
- Other railways require a control length of a signal that is longer than the block section (Fig.3.1).



(a) Line without block overlaps

3.1 Basic Rules of Fixed Block Operation

- On railways where block overlaps are not required, the control length of a signal equals the block section.
- Other railways require a control length of a signal that is longer than the block section (Fig.3.1).



(b) Line with block overlaps

3.1 Basic Rules of Fixed Block Operation

■ Note:

- ◆ The difference is called “overlap” because in that area the control length of a signal overlaps with the control length of the next signal.
- ◆ The main purpose of the overlap is to provide additional safety in case the driver fails to brake before a stop signal.
- ◆ A signal may not be cleared until the full control length is clear. Thus, the **clearing point** behind a signal equals the end of the control length of the signal in rear.
- ◆ Block overlaps are used on all European railways, many railways outside of Europe and also on almost all subways and subway-like electric city railways worldwide.

3.2 Blocking Time and Headway Theory

■ Headway

- ◆ The **headway** is the time interval between two following trains.
- ◆ The **minimum** headway on a line with a fixed block system depends on the so called “**blocking time**”.

■ Blocking Time

- ◆ The blocking time is the time interval in which a section of track (usually a block section) is **exclusively allocated** to a train and therefore blocked for other trains.
- ◆ So the blocking time lasts from **issuing** a train its **movement authority** (e.g. by clearing a signal) to the possibility of issuing a movement authority to another train to enter that same section.
- ◆ The blocking time of a track element is usually much longer than the time of the train occupies the track element.

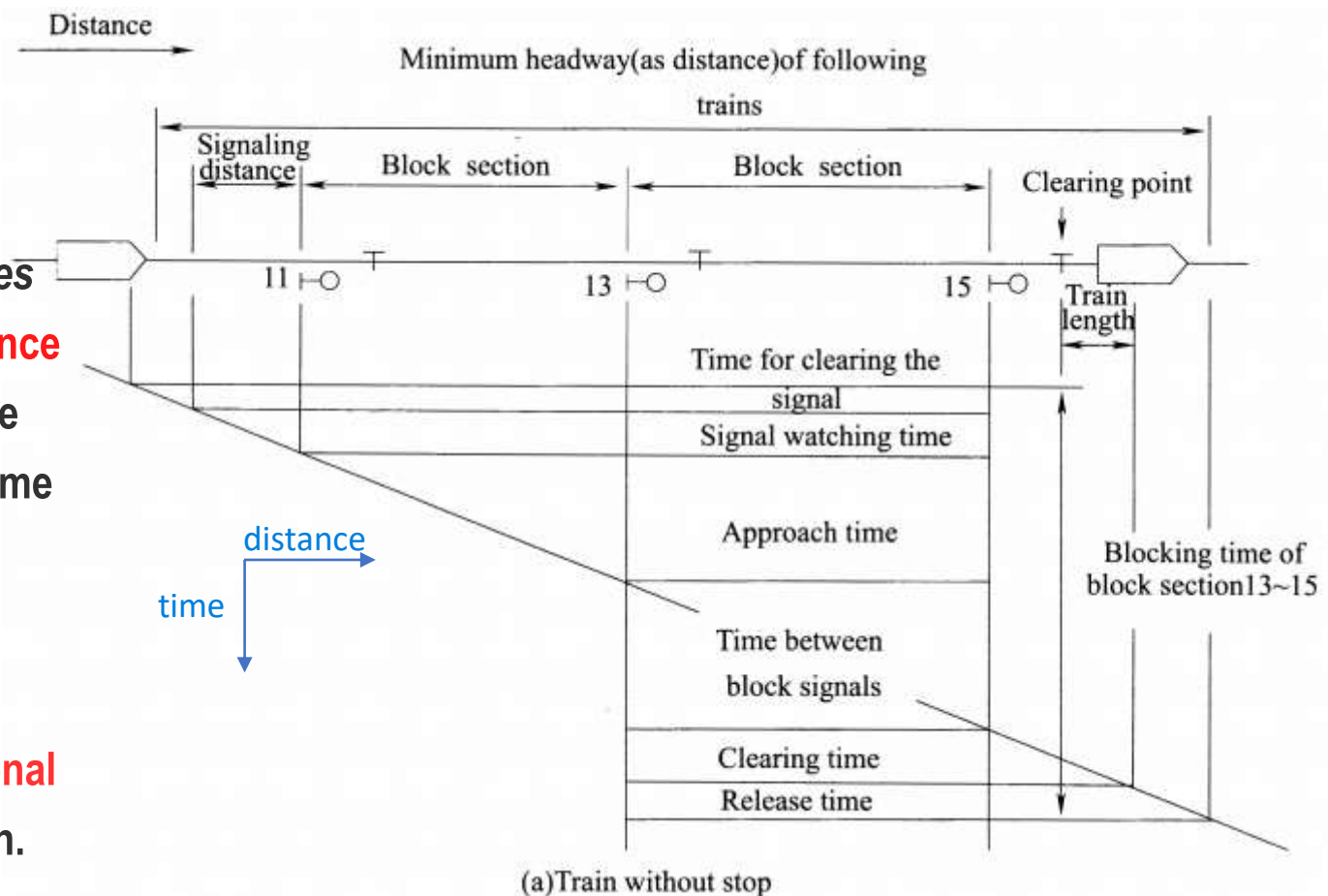
3.2 Blocking Time and Headway Theory

- In a territory with lineside signals the blocking time of a block section consists of the following time intervals.
 - ◆ The time for clearing the signal.
 - ◆ A certain time for the driver to view the **clear aspect** at the signal in rear that gives the **approach indication** to the signal at the entrance of the block section (this can be the block signal in rear or a separate **distant signal**).
 - ◆ The approach time between the signal that provide the approach indication and the signal at the entrance of the block section.
 - ◆ The time between the block signals.
 - ◆ The clearing time to clear the block section and if required the overlap with the full length of the train.
 - ◆ The **release** time to “unlock” the block system.

3.2 Blocking Time and Headway Theory

- In a territory with **cab signaling** the principle is quite similar but the **approach time** is now the time the trains run through the braking distance that is signaled by the cab signal system.

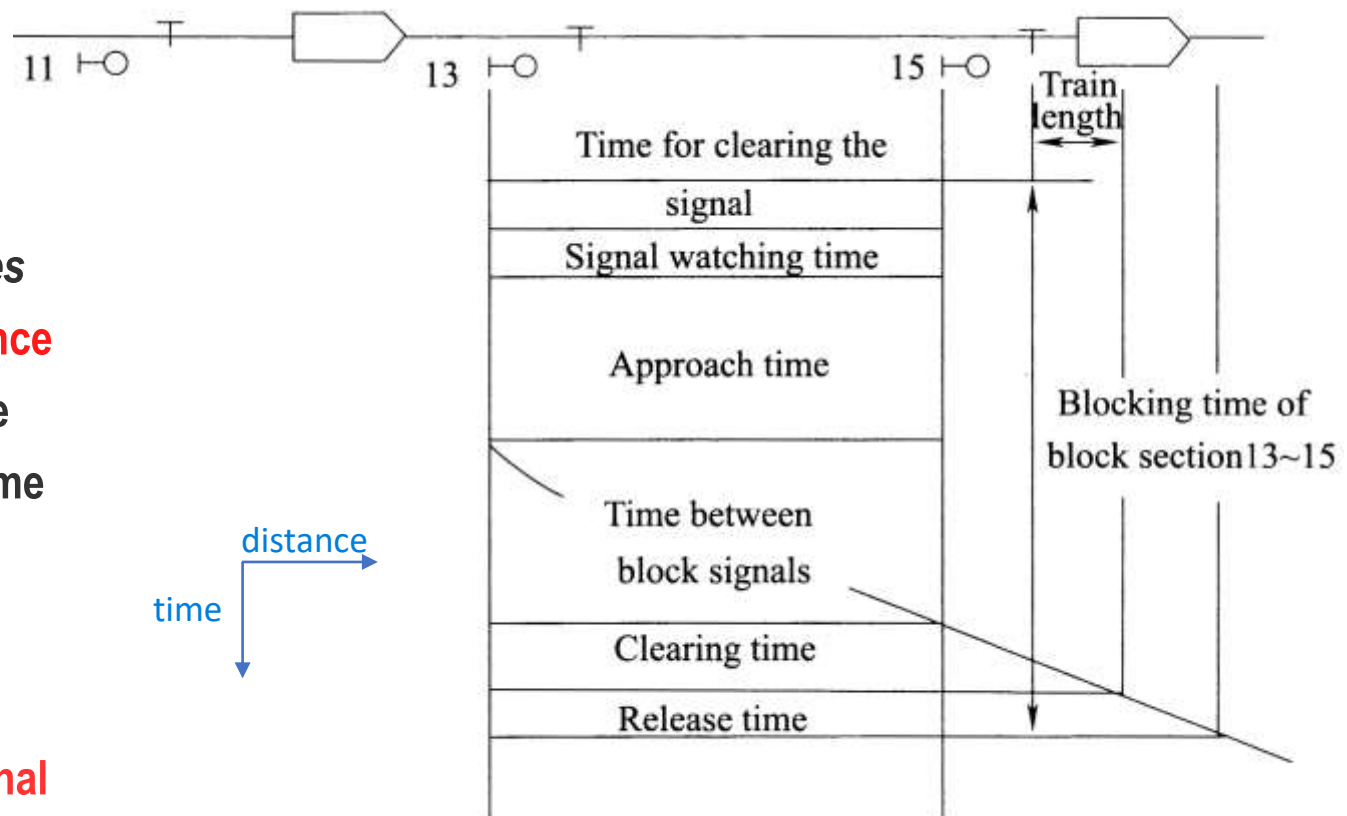
- Drawing the blocking times of all block sections a train passes into a time over distance diagram it leads to the so called “blocking time stairway (Fig.3.2).
- The blocking time stairway represents perfectly the **operational use** of a line by a train.



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- ◆ **Drawing** the blocking times of all block sections a train passes into a **time over distance** diagram it leads to the so called “blocking time stairway (Fig.3.2).
- ◆ The blocking time stairway represents perfectly the **operational use** of a line by a train.



(b) Train with stop

3.2 Blocking Time and Headway Theory

- With the blocking time stairway it is possible to determine the minimum headway of two trains (Fig.3.3).
 - ◆ The blocking times directly **establishes** the signal headway **as** the minimum time interval between two following trains in each block section.

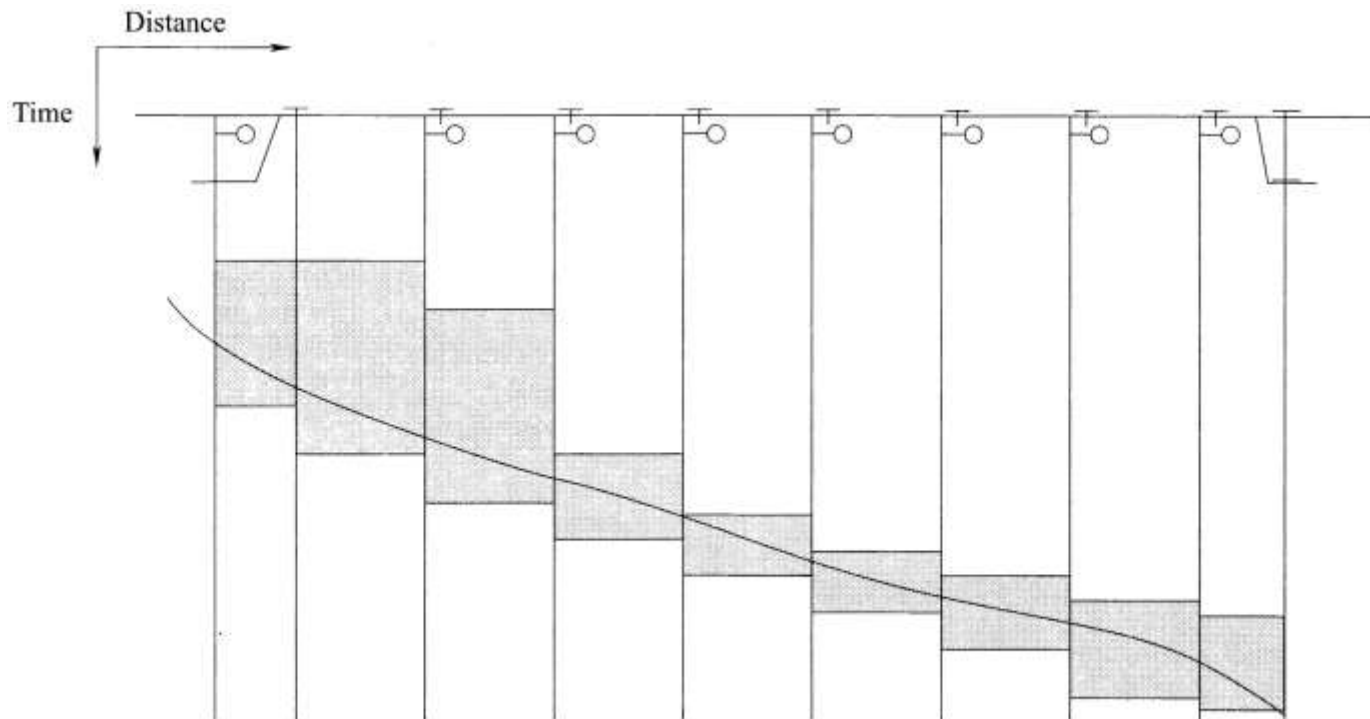


Fig. 3. 3 Blocking time “stairway”

3.2 Blocking Time and Headway Theory

- The line headway is the minimum headway between two trains not only considering one block section but the whole blocking time stairways of the line.
 - ◆ In this case the blocking time stairways of two following trains **touch** each other **without any tolerance** in at least one block section (the “**critical block section**”) (Fig.3.4).

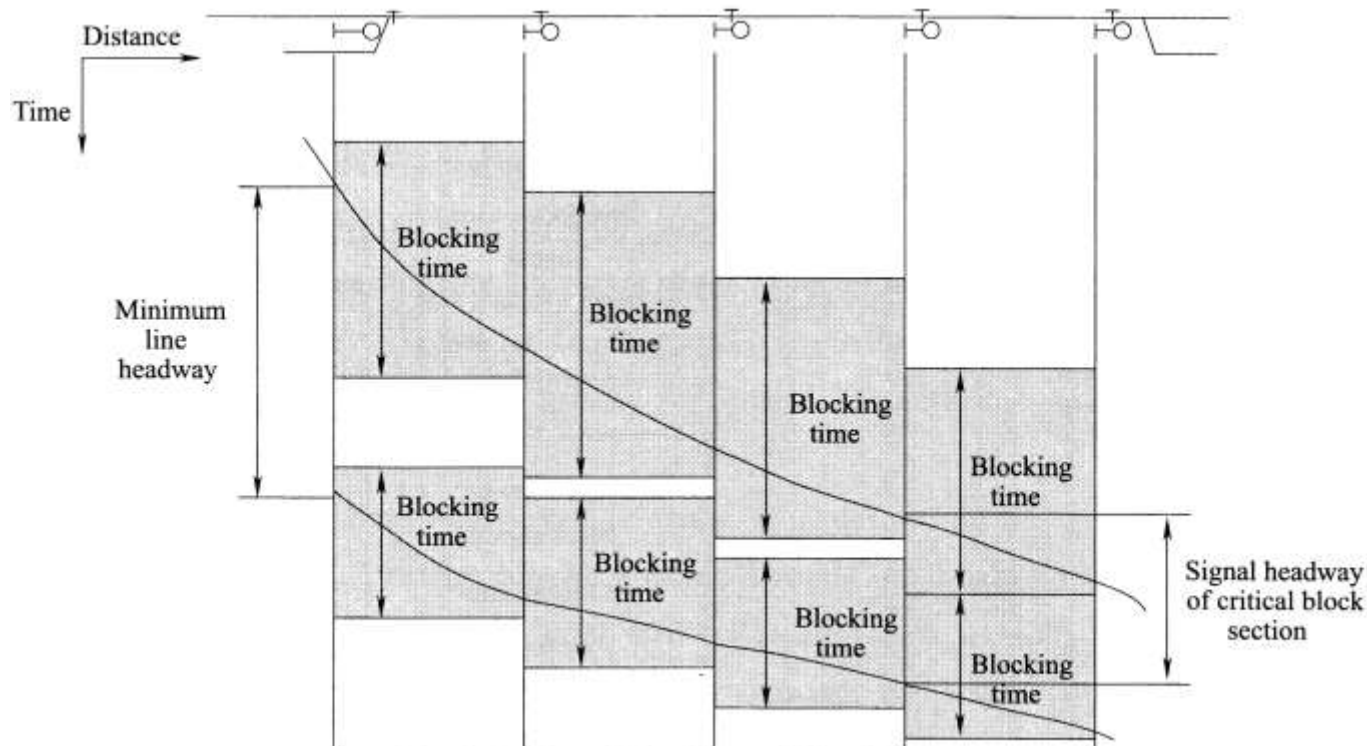


Fig. 3. 4 Signal headway and line headway

3.2 Blocking Time and Headway Theory

- On lines with **mixed traffic** the minimum line headway depends **significantly** on the speed differences between trains.
 - ◆ On lines where all trains run with **quite the same** speed (typical on electric city railways) the critical block sections are usually the block sections in which the blocking time included the **dwell time** of stops (station sections, Fig.3.5).

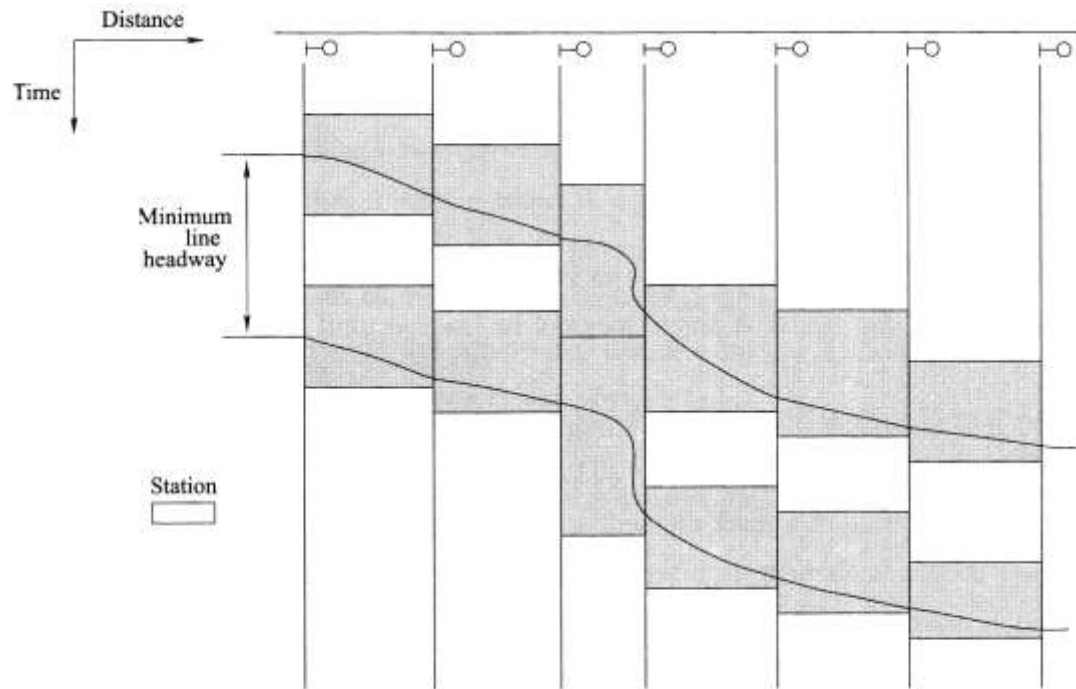


Fig. 3.5 Minimum line headway on an electric city railway

3.2 Blocking Time and Headway Theory

- On lines which are operated with a **moving block** system there can also be determined a blocking time.
 - ◆ On a moving block line, the length of the block sections is reduced to zero. That means the running time between the block signals will be **eliminated**.
 - ◆ But all other **components** of the blocking time can also be found in moving block. On most lines, the sum of these other components is even much greater than the part of the blocking time that can be eliminated by moving block.
 - ◆ In difference to a line with fixed block sections, only the “steps” of the blocking time “stairway” will be eliminated and the blocking time diagram will be transformed into a continuous time **channel**.

Homework

- Pages 26~27

- ◆ 1

- ◆ 2

- ◆ 3: (1), (3)

- ◆ 4: (1)