BRITISH STANDARD

BS 7669-3: 1994

Vehicle restraint systems —

Part 3: Guide to t he installation, inspection and repair of safety fences

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee B/509, Road equipment, to Subcommittee B/509/12, Vehicle safety fences and barriers, upon which the following bodies were represented:

Association of Safety Fencing Contractors
British Cement Association
British Steel Industry
County Surveyors' Society
Department of Transport (Transport Research Laboratory)
Fencing Contractors Association
Fencing Industries Association
Institution of Civil Engineers
Institution of Highways and Transportation
Royal Society for the Prevention of Accidents
The Highways Agency of the Department of Transport

This British Standard, having been prepared under the direction of the Technical Committee B/509, was published under the authority of the Standards Board and comes into effect on 15 September 1994

The following BSI references relate to the work on this standard:
Committee reference B/509/12
Draft for comment 90/14988 DC

ISBN 0 580 22178 4

Amendments issued since publication

Amd. No.	Date	Comments

Contents

Foreword

This Part of BS 7669 has been prepared under the direction of Technical Committee B/509 Road Equipment.

Over the last 25 years the Department of Transport, the Transport Research Laboratory, British Standards Institution and other organizations have been involved in research, testing, design and the preparation of specifications and standards for vehicle restraint systems such as safety fences, barriers and bridge parapets. Much of this work has been published in the form of Transport Research Laboratory reports, drawings, specifications and standards.

Over recent years, particularly since the introduction of quality assurance schemes for both the manufacture of components and the erection of safety fences and parapets, the need for additional advice, guidance and background information has been highlighted. In 1988 the Department of Transport and British Standards Institution agreed to the preparation of a comprehensive British Standard or Reference Manual on vehicle restraint systems.

A steering group of representatives from the British Standards Institution, Department of Transport and Transport Research Laboratory was formed to supervise the project and the following terms of reference were formulated:

> "To prepare the draft of a comprehensive document on safety fences, barriers and bridge parapets covering research and development, design, specification, manufacture, installation, repair and maintenance."

It was decided to split the Reference Manual into several Parts and the following groups were formed:

a) Working Group 1 — Part 1 (in preparation), dealing with the fundamentals of safety fences, barriers, parapets and transitions

b) Working Group 2 — Part 2 (in preparation), dealing with the specification and layout of safety fences and barriers

c) Working Group 3 — Part 3, dealing with the installation, inspection and repair of safety fences

d) Working Group 3 — Part 4 (in preparation), dealing with the installation, inspection and repair of safety barriers

e) Working Group 4 — Part 5 (future work), dealing with all aspects of bridge parapets

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 76, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

blank

Section 1. General

1.1 Scope

This Part of BS 7669 provides guidance on the installation and erection procedures for vehicle safety fences. It is also designed as a follow-on to in-service inspection and for use following damage to fences.

NOTE This guide includes supplementary commentaries to assist in its use and understanding.

1.2 References

1.2.1 Normative references

This Part of BS 7669 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendments to, or revisions of, any of these publications apply to this Part of BS 7669 only when incorporated in it by updating or revision.

1.2.2 Informative references

This Part of BS 7669 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this Part of BS 7669 the definitions given in the following Parts of BS 6579 apply: BS 6579-1:1988, BS 6579-3:1988, BS 6579-4:1990, BS 6579-5:1986, BS 6579-6:1988, and BS 6579-7:1989.

1.4 Health and safety

1.4.1 The investigation and implementation of safety fence projects, including inspection and repair works, require personnel to work on the highway. All personnel including those dealing with the design and supervision functions should seek to ensure that safe working practices can be achieved and adopted at all times. No operation should cause danger to employer, employee, contractor, subcontractor or any member of the public. Inconvenience should be kept to the minimum by careful preplanning of the works. The contractor should ensure that the Engineer is provided with the name of the contractor's nominated representative who will have site management responsibility for the safety fence work.

1.4.2 Publications available on safety include:

a) Health and Safety at Work etc. Act 1974 [1];

b) *Traffic Signs Manual* Chapter 8, specifically, *Traffic Safety Measures and Signs for Roadworks and Temporary Situations* [2];

c) *Safety at Roadworks, Notes for Guidance* [3];

d) *Planning for Safety — Guidance Notes for the Health and Safety of Workers at In-service Motorway Roadworks Sites* [4];

e) Control of Substances Hazardous to Health Regulations, 1988, as amended by SI 1990 No. 2026, 1990 [5];

f) Construction (Lifting Operations) Regulations 1961 [6];

g) Construction (General Provisions) Regulations 1961 [7].

1.4.3 The Engineer, contractor and employer responsible for the project should ensure compliance with the above guidance/manuals whereby problems can be minimized by consideration of items such as:

a) interference with the public utility apparatus or other underground services — national/local Highway Authority and Utilities Committee (HAUC) arrangements;

b) implementation of health and safety manuals — protective clothing, head, limb, lung and eye protection, safe working practices (including materials);

c) the general needs of the public — clear signing, maintenance of traffic flow, protection of workers and night/weekend working;

d) arrangements made for dealing with emergencies — contact with local emergency services.

1.5 Dealing with services

Before any work is commenced or marking pins are driven through the highway surface, details of all underground services and equipment should be obtained and shown on the working drawings. Where necessary, services may need to be diverted by the appropriate authority to accommodate the agreed safety fence layout.

In all cases, the service authority should mark out the position of their services on the ground using the agreed HAUC colour code system, prior to any safety fence work commencing.

1.6 Setting out

Before safety fence erection work commences, the engineer should agree the setting out for:

a) terminal sections/flares;

b) straight and curved safety fences;

c) the type of safety fence, including post and foundations (and antiglare screen fencing fixings, if specified) in relation to all locations;

d) the location of tensioner assemblies, adjuster assemblies, expansion assemblies and expansion joints;

e) the location of reinforcement (preferably utilizing a cover meter) and waterproofing materials where surface-mounted posts are to be installed;

f) the beam/rope height (see Figure 1). The engineer should also ensure that posts do not coincide with underground chambers, services, manhole covers etc., especially where post spacing is at half standard centres.

1.7 Achievement of torque and tension values

Torque should be measured with a calibrated torque wrench in accordance with BS 6703:1988.

Tension in a wire rope should be measured with a calibrated rope tension indicator.

COMMENTARY. *Instruments should be calibrated at least annually*.

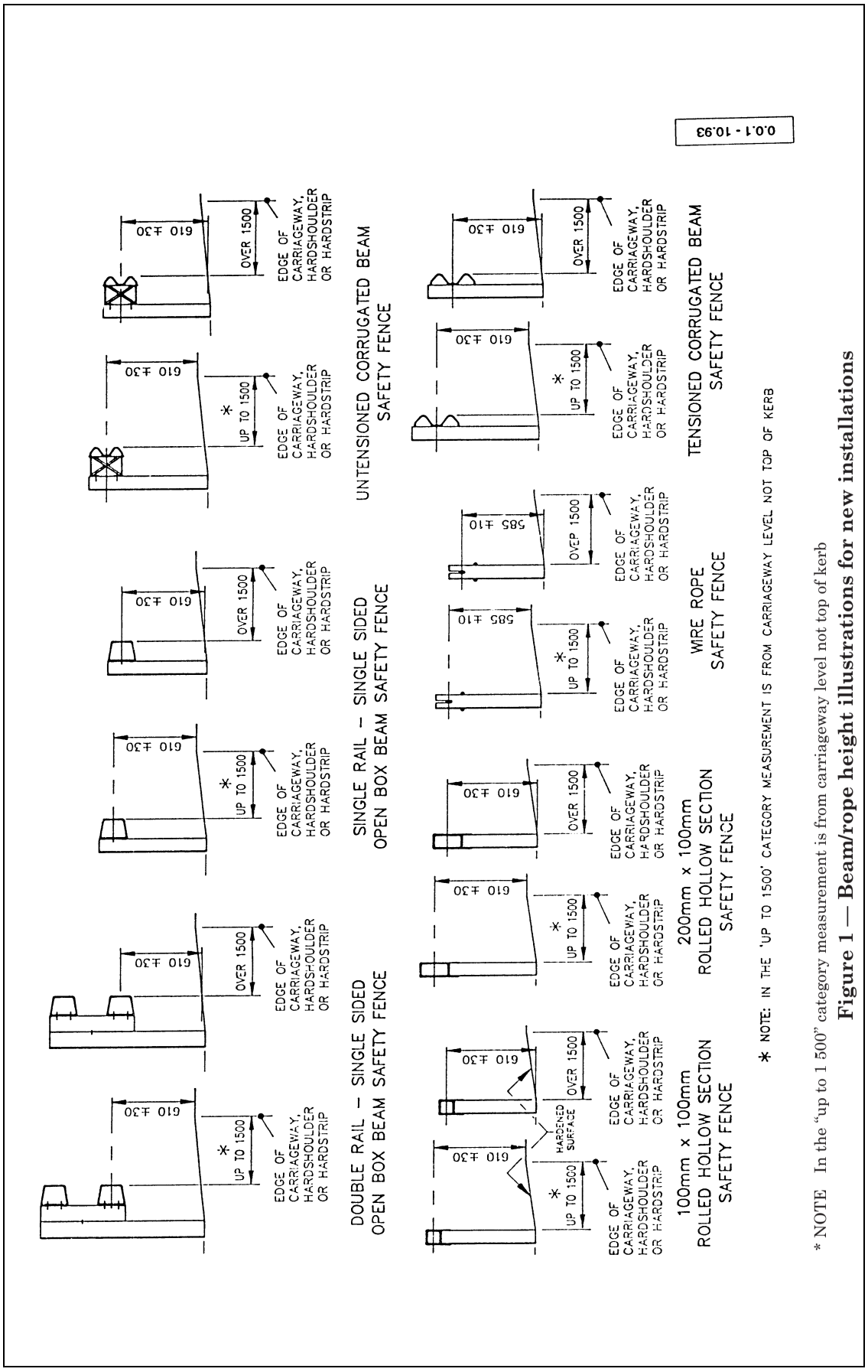


Figure 1 — Beam/rope height illustrations for new installations

* NOTE In the "up to 1 500" category measurement is from carriageway level not top of kerb

Section 2. Installation procedures for erection of safety fences

2.1 Tensioned corrugated beam

2.1.1 Single sided tensioned corrugated beam (Figure 2)

2.1.1.1 *Mark out*

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of posts.

2.1.1.2 *For driven posts*

a) Establish post centre referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that the radiused edge of post faces oncoming traffic.

COMMENTARY. *Line of beams may be laid out along the setting out line as a guide for the post-driving rig provided care is taken to avoid damage to the beams.*

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.1.1.3 *Concrete foundations*

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.1.1.4 *Filter drain foundations*

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

*On figure 2 and subsequent figures HCD refers to *Highway Construction Details* [8]

Figure 2 — Single sided tensioned corrugated beam (verge)

b) In existing filter drains

i) Excavate for the foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.1.1.4** a).

2.1.1.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.1.1.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.1.1.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.1.1.7 ***Terminal section***

a) Excavate for anchor block and angled beam post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used. Anchorage bolts should have the nuts adjacent to the fairing.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert reinforcing bars or cast-in cradle anchor block and reinforcing rings at post foundations.

e) Recompact concrete. Slope concrete away from terminal section supports, to prevent formation of corrosion pockets. Finish to level and cure.

f) Install concrete fairings to terminals, ensuring that the concrete is flush with traffic face of beam. Concrete fairing should follow slope of end beam for a minimum of 700 mm.

COMMENTARY.

A precast concrete fairing may be installed as an alternative to in-situ concrete fairing, subject to approval of the Engineer.

2.1.1.8 ***Assembly***

a) Hang beams onto posts using hand tightened post screws.

b) Couple together beams in one of the following methods.

COMMENTARY. *Assemble lap, joint with overlap in direction of traffic flow.*

Method 1

i) Loose assemble all the beams using lap screws, nuts and washers without tightening the lap joint.

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar). (See Figure 3.)

iii) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m, before tensioning.

Method 2

i) Hang a single beam to a previously erected beam using loosely assembled lap screws, nuts and washers.

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar).

iii) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m. Continue to next beam.

2.1.1.9 *Tensioning*

a) Check that each limit of the length of assembled fence to be tensioned is anchored.

COMMENTARY. *The following are effective means of anchorage:*

i) a ramped end anchorage;

ii) a continuing length of assembled tensioned corrugated beam fence at least 140 m *long;*

iii) a continuing length of assembled open box beam fence at least 30 m *long;*

iv) a full height anchorage;

v) a continuing minimum length of 14.4 m *of assembled open box beam fence connected to a bridge parapet;*

b) Check that post screws, nuts and washers have been only hand tightened.

c) When a continuous length of tensioned corrugated beam fence is used as anchorage, tighten post screws on the anchor length to a torque of 15 N · m to 20 N · m.

d) Hand tighten adjuster nuts up to adjuster brackets, and at full height anchorages hand tighten nuts on anchor bolts up to adjuster brackets.

e) For anchorage type bolts i).

i) Tighten nuts on anchor at ramped end anchorage until the angled beam post nearest the end post just maintains vertical alignment. Tighten lock nuts to a torque of 140 N · m to 160 N · m.

ii) At the adjuster assembly adjacent to each effective anchorage tighten all adjuster nuts to a torque of 280 N · m to 300 N · m and check for any movement in the ground anchorage.

COMMENTARY. *If movement is observed in the ground anchorage, the Engineer should immediately be informed.*

iii) Slacken all adjuster nuts and retighten to a torque appropriate to the ambient temperature (see Table 1). Tighten both lock nuts to a torque of 140 N · m to 160 N · m.

iv) At each subsequent adjuster assembly tighten both adjuster nuts to a torque appropriate to the ambient temperature (see Table 1). Tighten all lock nuts to a torque of 140 N · m to 160 N · m.

COMMENTARY. *A clearance socket has to be used which will permit the torque wrench to be applied to the adjuster nut.*

f) For anchorage types ii), iii), iv) and v) above tighten all adjuster nuts at all adjuster assemblies to a torque appropriate to the ambient temperature (see Table 1). Tighten all lock nuts to a torque of 140 N · m to 160 N · m.

COMMENTARY. *When a continuing length of assembled tensioned corrugated beam at least* 140 m *long is used as an effective temporary anchorage, the post screws should be slackened (i.e. hand tightened) prior to tensioning of the new length.*

It is necessary to retighten the pairs of adjuster nuts several times alternately in order to tighten both to the specified torque.

Table 1 — Torque for single sided tensioned corrugated beam

Ambient temperature °C	**Torque** N · m
25	0 (hand tight)
20	50
15	100
10	150
5	200
0	250
– 5	300

COMMENTARY on Table 1.

i) Interpolation of values is allowed.

ii) Tolerance on torque to be ± 5 %.

iii) Tensioning should not be undertaken outside the 25 °C *to* – 5 °C *range.*

g) Tighten post screws to a torque of 15 N · m to 20 N · m.

COMMENTARY. *The torque wrench has to be applied to the screw head.*

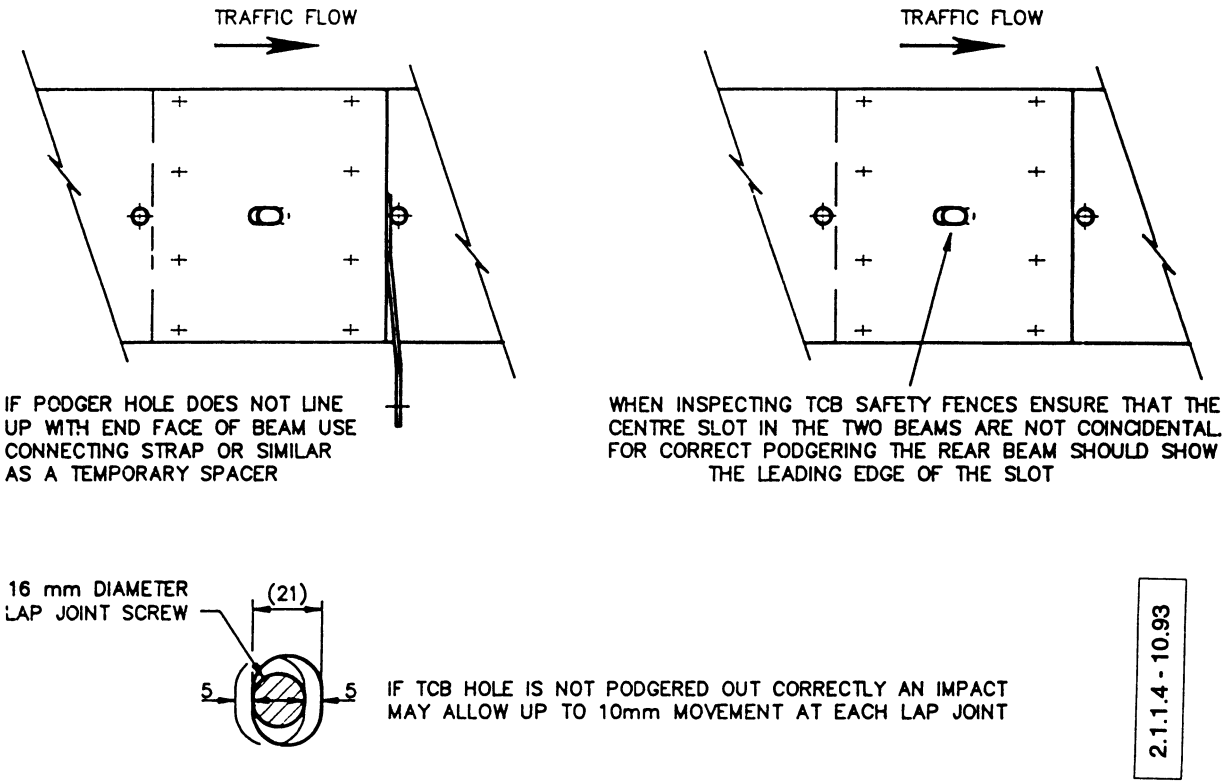


Figure 3 — Tensioned corrugated beam (TCB) lap joint assembly arrangements

2.1.2 Double sided tensioned corrugated beam (Figure 4)

2.1.2.1 ***Mark out***

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of fence or expansion joint anchorage.*

e) Mark out types of posts.

2.1.2.2 ***For driven posts***

a) Establish post centre, referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centres should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

COMMENTARY. *Line of beams may be laid out along the setting out line as a guide for the post-driving rig provided care is taken to avoid damage to the beams.*

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.1.2.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.1.2.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for the foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.1.2.4** a).

2.1.2.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.1.2.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.1.2.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm and 30 mm should be placed under a surface-mounted post unless it is attached to a steel base.

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

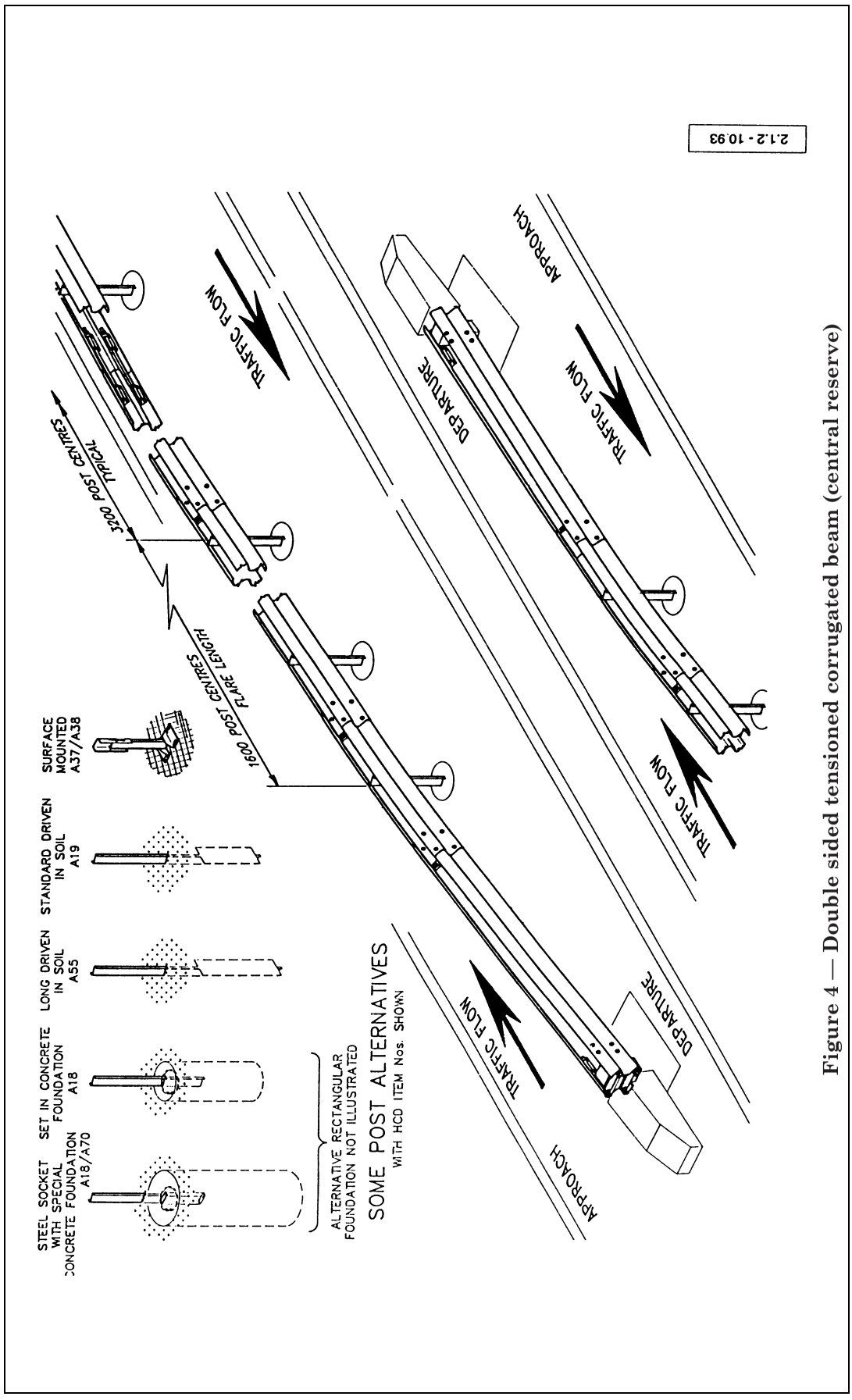


Figure 4 — Double sided tensioned corrugated beam (central reserve)

2.1.2.7 *Terminal section*

a) Excavate for anchor block and angled beam post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used. Anchorage bolts should have the nuts adjacent to the fairing.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert reinforcing bars or cast-in cradle in anchor block and reinforcing rings at post foundations.

e) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

f) Install concrete fairings to terminals, ensuring that the concrete is flush with both faces of beam. Concrete fairing should follow slope of end beam for a minimum of 700 mm.

COMMENTARY.

A precast concrete fairing may be installed as an alternative to in-situ concrete fairing, subject to the approval of the Engineer.

2.1.2.8 *Assembly*

a) Hang beams onto posts using hand tightened post screws.

COMMENTARY. *Ensure adjuster assemblies are installed opposite each other.*

b) Couple together beams and connecting straps on one side of the posts in one of the following methods:

COMMENTARY.

i) Assemble lap joint with overlap in direction of traffic flow.

ii) If double length beam is used, fix additional connecting straps at mid point of beam in addition to the lap joints.

Method 1

i) Loose assemble all the beams using lap screws, washers and nuts, without tightening the lap joint.

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar). (See Figure 3.)

iii) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m, except for those holding the connecting strap.

Method 2

i) Hang a single beam to a previously erected beam using loosely assembled lap screws, washers and nuts.

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar).

iii) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m, except for those holding the connecting straps. Continue to next beam.

c) Couple together beams on other side in one of the following methods:

Method 1

i) Loose assemble all the beams using lap screws, nuts and washers without tightening the lap joint.

COMMENTARY. *Problems may occur with double sided fence on bends. Where joints do not line up opposite each other and the position of post bolt in slot is affected, this can be corrected at adjuster assemblies and additional pairs of assemblies may be introduced.*

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar).

iii) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m, except for those holding the connecting straps.

Method 2

i) Hang a single beam to a previously erected beam using loosely assembled lap screws, washers, and nuts.

ii) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar).

iii) Tighten the remaining lap screws to a torque of 60 N · m to 80 N · m, except for those holding the connecting straps. Continue to next beam.

2.1.2.9 *Tensioning*

a) Check that each limit of the length of assembled fence to be tensioned is anchored.

COMMENTARY. *The following are effective means of anchorage:*

i) a ramped end anchorage;

ii) a continuing length of assembled double sided tensioned corrugated beam fence at least 140 m *long;*

iii) a continuing length of assembled double sided open box beam fence at least 30 m *long;*

iv) a full height anchorage;

v) a continuing minimum length of 14.4 m *of assembled open box beam fence connected to a bridge parapet;*

b) Check that post screws have been only hand tightened.

c) When a continuous length of tensioned corrugated beam double sided fence is used as anchorage, tighten post screws on the anchor length to a torque of 15 N · m to 20 N · m.

d) Hand tighten adjuster nuts up to adjuster brackets and at full height anchorages hand tighten nuts on anchor bolts up to adjuster brackets.

e) For anchorages types i).

i) Tighten anchorage nuts on anchor bolts at ramped end anchorage until the angled beam post nearest the end post just maintains vertical alignment. Tighten lock nuts to a torque of 140 N · m to 160 N · m.

ii) At the adjuster assembly adjacent to each effective anchorage tighten all adjuster nuts to a torque of 280 N · m to 300 N · m and check for any movement in the ground anchorage.

COMMENTARY. *If movement is observed in the ground anchorage, the Engineer should immediately be informed.*

iii) Slacken all adjuster nuts and retighten to a torque appropriate to the ambient temperature (see Table 2). Tighten all lock nuts to a torque of 140 N · m to 160 N · m.

iv) At each subsequent adjuster assembly tighten adjuster nuts to a torque appropriate to the ambient temperature (see Table 2). Tighten all lock nuts to a torque of 140 N · m to 160 N · m.

COMMENTARY. *A clearance socket has to be used which will permit the torque wrench to be applied to the adjuster nut.*

f) For anchorage types ii), iii), iv) and v) above tighten all adjuster nuts at all adjuster assemblies to a torque appropriate to the ambient temperature (see Table 2). Tighten all lock nuts to a torque of 140 N · m to 160 N · m.

COMMENTARY. *When a continuing length of assembled tensioned corrugated beam at least* 140 m *long is used as an effective temporary anchorage, the post screws should be slackened (i.e. hand tightened) prior to tensioning of the new length.*

It is necessary to retighten the pairs of adjuster nuts several times alternately in order to tighten both to the specified torque.

Table 2 — Torque for double sided tensioned corrugated beam

Ambient temperature °C	Torque N · m
25	0 (hand tight)
20	50
15	100
10	150
5	200
0	250
– 5	300

COMMENTARY on Table 2.

i) Interpolation of values is allowed.

ii) Tolerance on torque to be ± 5 %.

iii) Tensioning should not be undertaken outside the 25 °C *to* – 5 °C *range.*

g) Tighten post screws to a torque of 15 N · m to 20 N · m.

COMMENTARY. *The torque wrench has to be applied to the screw head.*

h) Tighten the lap screws securing the connecting straps to a torque of 60 N · m to 80 N · m.

2.1.3 Full height surface mounted anchorages (Figure 5)

2.1.3.1 ***Mark out***

a) Determine type of full height anchorage.

b) Establish position of full height anchorage in line of fence.

COMMENTARY. *This should be relative to bridge parapet, direction of fence or expansion joint movement requirements.*

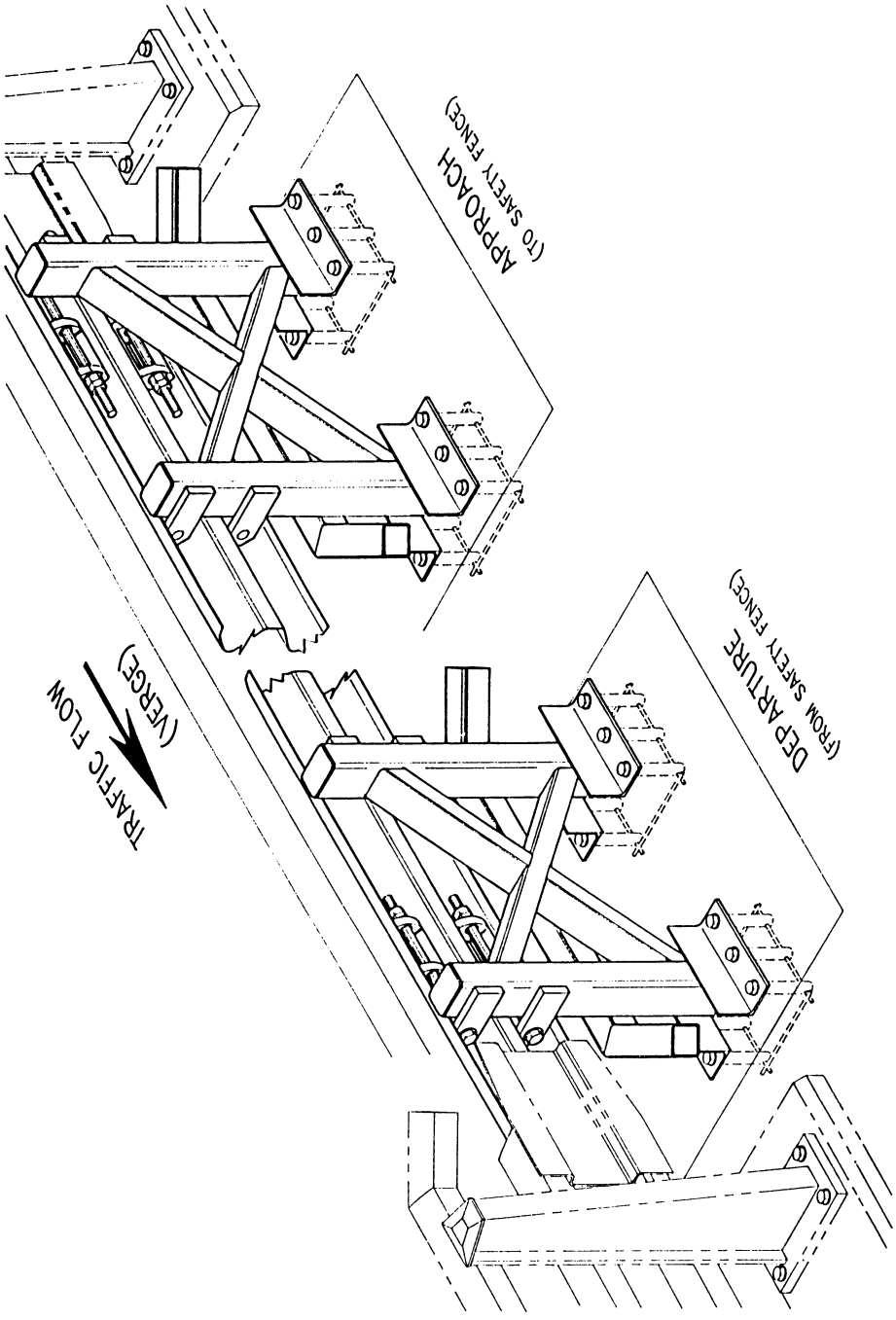


Figure 5 — Tensioned corrugated beam full height anchorages

2.1.3.2 *Installation*

a) Excavate for concrete foundation. Dispose of excess arisings.

b) Where cradle anchorage is to be used support in position.

c) Place concrete, vibrate and compact.

d) Finish and cure as specified.

e) Position full height anchorage unit to the specified height on concrete base.

COMMENTARY. *e) to g) will not be necessary if cradle anchorages have been already installed in base.*

f) Establish position of anchorage and attachment system.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

g) Select drill bit of correct diameter and type.

h) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

i) Flush clean the holes.

COMMENTARY. *This may be done with compressed air or water.*

j) Position full height anchorage over holes to check position.

k) Remove full height anchorage.

l) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

m) When secure, position full height anchorage over the attachment system and tighten fixings to the specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.1.3.3 *Connection to adjacent safety fence*

Connect to adjacent fence as required.

COMMENTARY. *Special beam lengths may be required.*

2.2 Untensioned corrugated beam

2.2.1 Single sided untensioned corrugated beam (Figure 6)

2.2.1.1 *Mark out*

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of post.

2.2.1.2 *For driven posts*

a) Establish post centre, referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

COMMENTARY. *Line of beams may be laid out along the setting out line as a guide for the post-driving rig provided care is taken to avoid damage.*

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.2.1.3 *Concrete foundations*

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

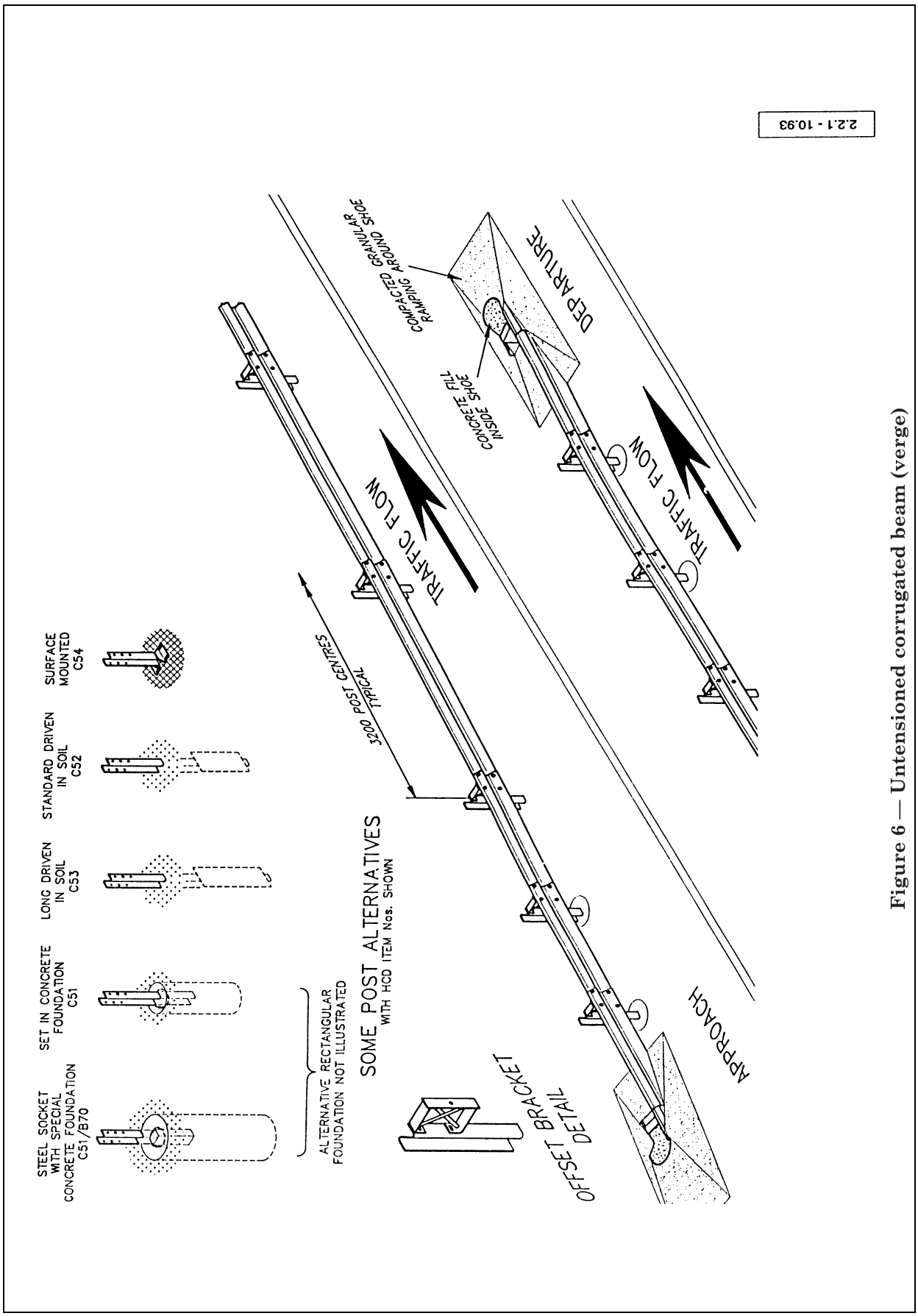


Figure 6 — Untensioned corrugated beam (verge)

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.2.1.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of the trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for the foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in [iv) to x)] of **2.2.1.4** a).

2.2.1.5 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the holes.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.2.1.6 ***Terminal section***

a) Excavate for end post and for angled beam post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used.*

b) Assemble terminal section and support in correct position.

c) Place specified fill and compact specified fill for end post.

d) Place concrete, vibrate and compact for angled beam posts.

e) Insert reinforcing rings.

f) Recompact concrete. Finish to level and cure.

g) Install end shoe and fill with concrete to the specified finish.

h) Place specified fill to form ramp.

2.2.1.7 ***Assembly***

a) Hang off-set brackets onto posts and tighten screws to a torque of 30 N · m to 40 N · m.

b) Hang beams onto off-set brackets using hand tightened screws, nuts and washers.

c) Couple beams together using lap screws, nuts and washers.

d) Remove all slack from the lap joint using a tapered bar (podger bar) in the 20 mm diameter hole (podgering hole) and tighten two lap screws to a torque of 60 N · m to 80 N · m, before releasing the tapered bar (podger bar). (See Figure 3.)

e) Tighten remaining lap screws to a torque of 60 N · m to 80 N · m.

f) Tighten bolts securing beam to offset bracket to a torque of 60 N · m to 80 N · m.

2.2.1.8 ***Tensioning***

No tensioning is required except at full height anchorage parapet connections, where a torque of 120 N · m to 130 N · m is required.

2.2.1.9 ***Full height anchorages***

See **2.13** for method of installation.

2.3 Open box beam

2.3.1 Single sided open box beam (Figure 7)

2.3.1.1 ***Mark out***

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of posts.

2.3.1.2 ***For driven posts***

a) Establish post centre, referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.3.1.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.3.1.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

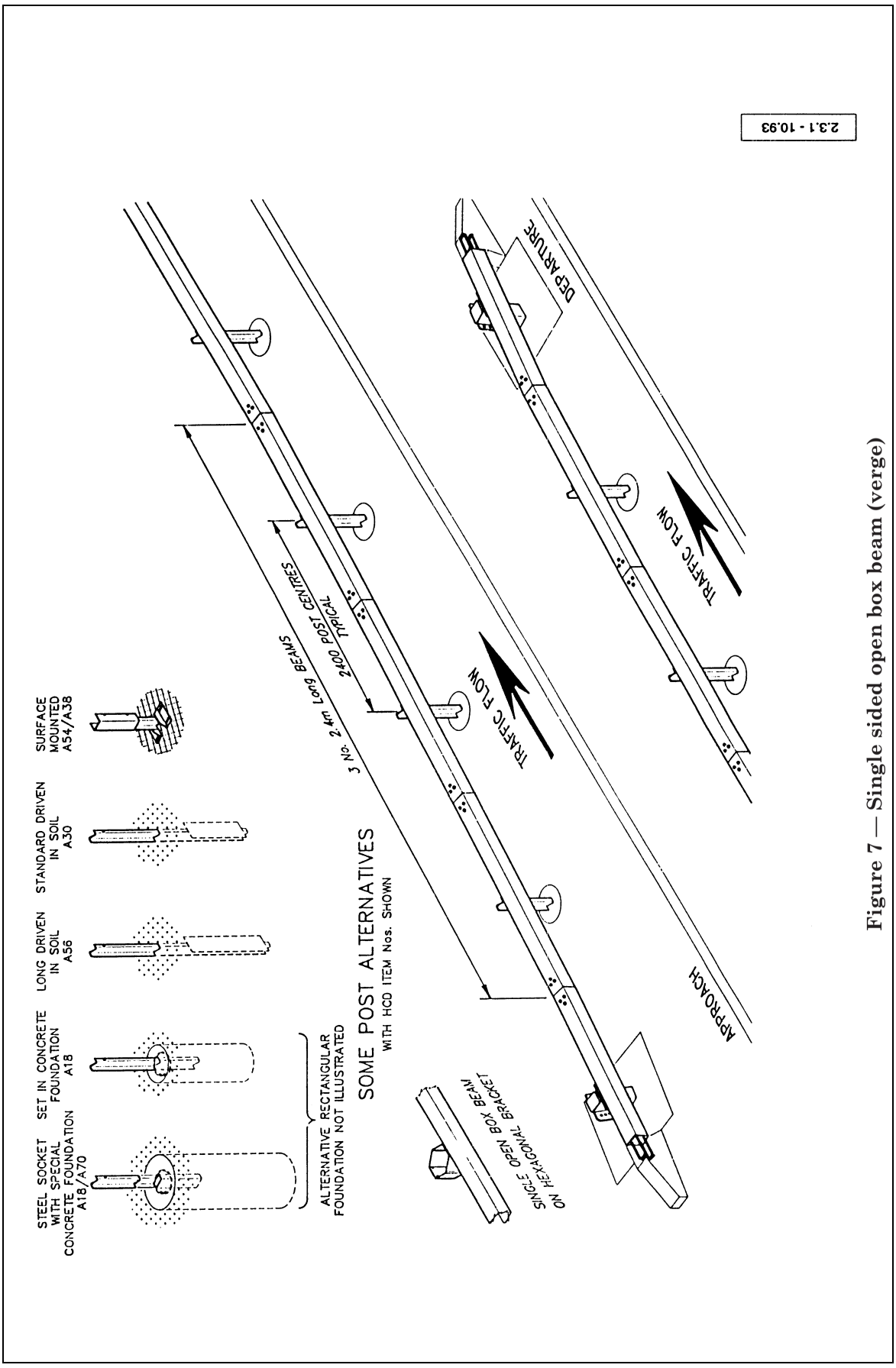


Figure 7 — Single sided open box beam (verge)

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that the radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for the foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.3.1.4** a).

2.3.1.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.3.1.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.3.1.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.3.1.7 ***Terminal section***

a) Excavate for anchor block and post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert cast-in cradle anchorage in anchor block when required and reinforcing rings at post foundations.

e) Recompact concrete. Slope concrete away from terminal section supports, to prevent formation of corrosion pockets. Finish to level and cure.

f) Install reinforcing bar and place concrete to form fairing to terminal, ensuring that the concrete is flush with face of beam. Concrete fairing should follow slope of end beam for a minimum of 250 mm.

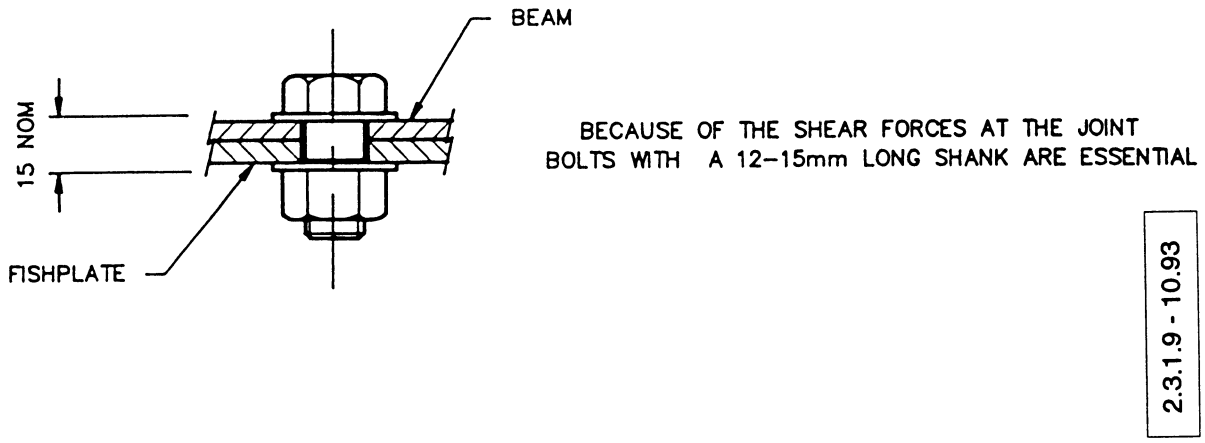


Figure 8 — Connecting bolt detail for open box beam

COMMENTARY. *A precast concrete fairing should be installed when using demountable terminals.*

2.3.1.8 ***Fixing bracket to structure***

a) Set out position of fixing brackets (horizontally and vertically).

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Ensure that the holes are made to full depth in the structure and brackets should not be fixed to non-structural facings. Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *Refer to specification for types of fixing. The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Install fixing brackets and fully tighten attachment system.

COMMENTARY. *Spacers may be required.*

2.3.1.9 ***Assembly***

a) Position beams adjacent to posts to check post spacing relative to stiffeners and beam joints.

COMMENTARY. *Ensure that expansion beam assemblies have been installed as specified.*

b) Hang beams onto posts using clamp plates and hand tightened post screws, nuts and washers.

c) Hang beams on fixing brackets if used.

d) Locate fishplates and install hand tightened connecting bolts.

COMMENTARY. *Ensure that the correct connecting bolt has been used. See Figure 8.*

e) Tighten all connecting bolts to a torque of 60 N · m to 80 N · m and tighten post screws to a torque of 25 N · m to 30 N · m.

COMMENTARY. *Use tolerance in clamp plates to achieve flowing alignment of fence. Check at joints that both beams form a flush joint and a flowing alignment at the traffic face.*

f) Ensure that no debris or surplus material is left within the beams.

2.3.2 Double sided open box beam (Figure 9)

2.3.2.1 ***Mark out***

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of posts.

2.3.2.2 ***For driven posts***

a) Establish post centre, referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.3.2.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.3.2.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for the foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.3.2.4** a).

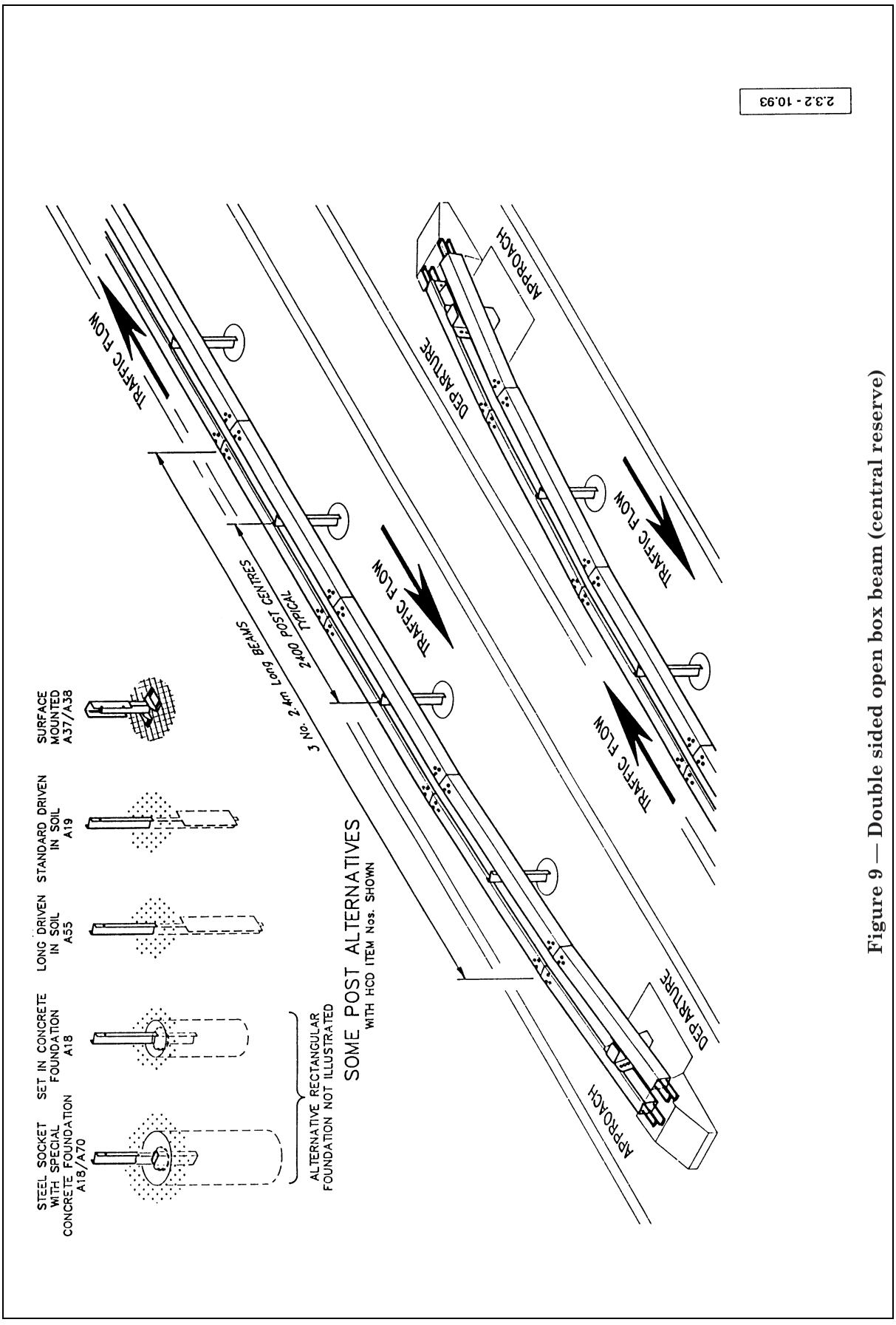


Figure 9 — Double sided open box beam (central reserve)

2.3.2.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.3.2.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.3.2.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* – 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.3.2.7 ***Terminal section***

a) Excavate for anchor block and post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert cast-in cradle anchorage in anchor block when required and reinforcing rings at post foundations.

e) Recompact concrete, finish to level and cure.

f) Install reinforcing bars and place concrete to form fairing to terminal, ensuring that the concrete is flush with face of each beam. Concrete fairing should follow slope of end beam for a minimum of 250 mm.

COMMENTARY. *A precast concrete fairing should be used when installing demountable terminals.*

2.3.2.8 ***Assembly***

a) Standard

i) Hang beams onto posts using clamp plates and hand tightened post screws, nuts and washers.

COMMENTARY. *Ensure that expansion assemblies have been installed as specified.*

ii) Locate fishplates and fit hand tightened connecting bolts.

COMMENTARY. *Ensure that the correct connecting bolt has been used. See Figure 8.*

iii) Tighten all connecting bolts to a torque of 60 N · m to 80 N · m. Tighten clamp plate screws to a torque of 25 N · m to 30 N · m.

iv) Ensure that no debris or surplus material is left within the beams.

b) At lighting columns/signs etc.

i) Ensure that radiused edge of spacers face oncoming traffic.

ii) Install spacers to posts using specified screws and tighten to a torque of 25 N · m to 30 N · m.

iii) Hang beams onto spacers using double hole clamp plates and hand tightened screws.

iv) Locate fishplates and fit hand tightened connecting bolts.

COMMENTARY. *Ensure that the correct connecting bolt is used. See Figure 8.*

v) Install stiffeners in required locations.

vi) Tighten all connecting bolts to a torque of 60 N · m to 80 N · m, clamp plate screws to a torque of 25 N · m to 30 N · m and stiffener fixing bolts to a torque of 30 N · m to 40 N · m.

vii) Ensure that no debris or surplus material is left within the beams.

2.3.3 Double rail, single sided open box beam (Figure 10)

2.3.3.1 ***Mark out***

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of posts.

2.3.3.2 ***For driven posts***

a) Establish post centre referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Drive post to specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.3.3.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.3.3.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for the foundation at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.3.3.4** a).

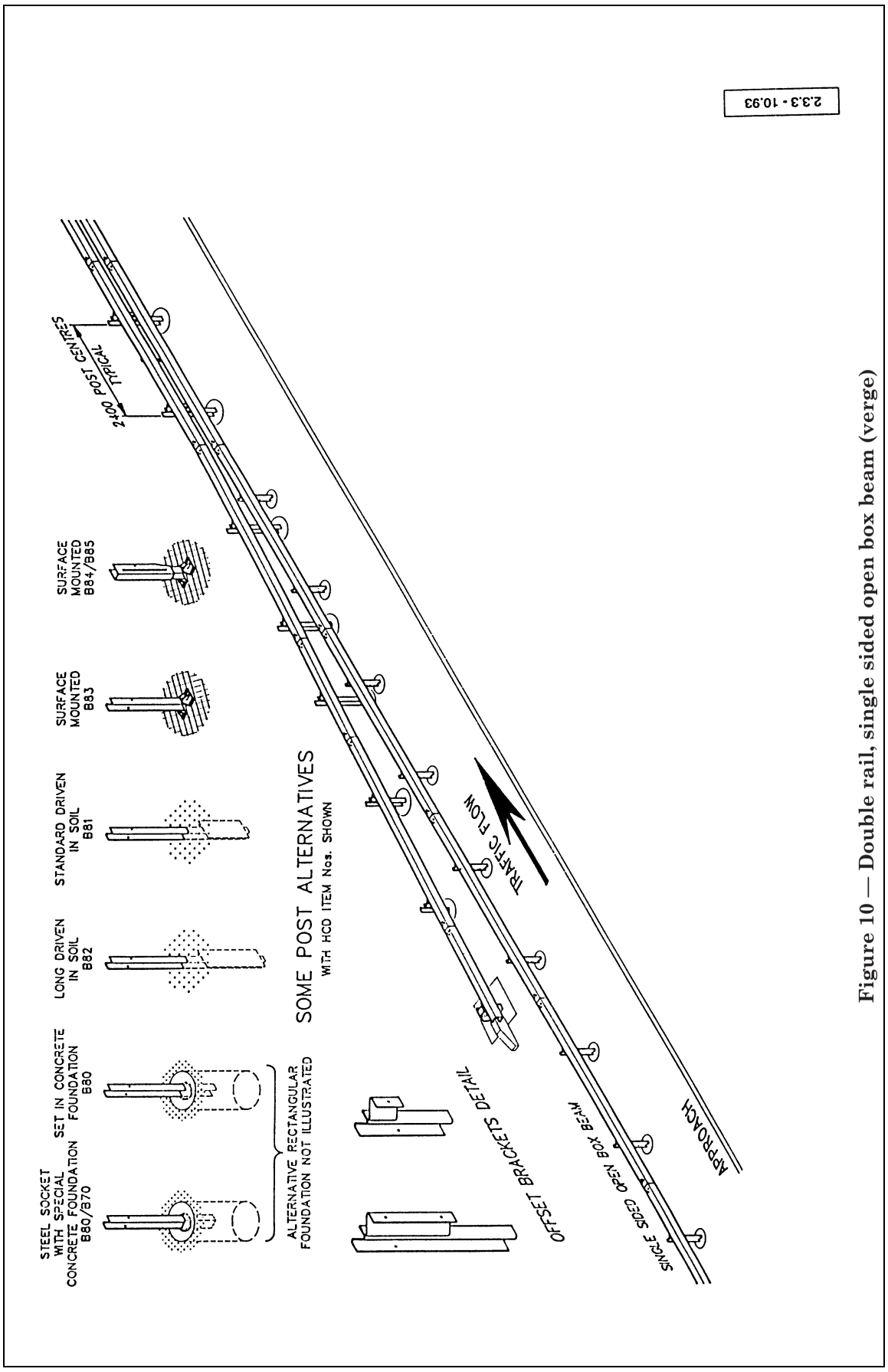


Figure 10 — Double rail, single sided open box beam (verge)

2.3.3.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.3.1.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.3.3.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment systems.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.3.3.7 ***Terminal section***

a) Excavate for anchorage block and angled beam post foundations. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert reinforcing rings in post foundations.

e) Recompact concrete. Slope concrete away from terminal section supports, to prevent formation of corrosion pockets. Finish to level and cure.

f) Install reinforcing bar and place concrete to form fairing to terminal, ensuring that the concrete is flush with face of beam. Concrete fairing should follow slope of end beam for a minimum of 250 mm.

2.3.3.8 ***Fixing bracket to structure***

a) Set out position of fixing brackets (horizontally and vertically).

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Ensure that the holes are made to full depth in the structure and brackets should not be fixed to non-structural facings. Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *Refer to specification for types of fixing. The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Install fixing brackets and fully tighten attachment system.

COMMENTARY. *Spacers may be required.*

2.3.3.9 ***Assembly***

a) Position beams adjacent to posts to check post spacing relative to stiffeners and beam joints.

COMMENTARY. *Ensure that expansion beam assemblies have been installed as specified.*

b) Install offset brackets using specified screws and tighten to 25 N · m to 30 N · m.

c) Hang beams for upper run of open box beam on offset brackets using clamp plates and hand tightened post screws.

d) Locate fishplates and install hand tightened connecting bolts.

COMMENTARY. *Ensure that correct connecting bolt has been used. See Figure 8.*

e) Install tie bar and hand tightened fixing bolts.

f) Hang beam for lower run of open box beam on offset bracket using clamp plates and hand tightened post bolts.

g) Locate fishplates and install hand tightened connecting bolts.

h) Tighten all bolts and screws to the following torques:

M10 to 25 N · m to 30 N · m;

M12 to 30 N · m to 40 N · m;

M16 to 60 N · m to 80 N · m.

COMMENTARY. *Use tolerance in clamp plates to achieve flowing alignment of fence. Check at joints that both beams form a flush joint and a flowing alignment at the traffic face.*

i) Ensure that no debris or surplus material is left within the beams.

2.3.4 Full height surface mounted anchorage

See **2.1.3** for method of installation.

2.4 Rectangular hollow section beam (Figure 11 and Figure 12)

2.4.1 Rectangular hollow section beam (100 mm × 100 mm and 200 mm × 100 mm)

2.4.1.1 ***Mark out***

a) Mark out a datum and establish the set-back.

COMMENTARY. *On finished wearing course, for example. Alternatively the datum could be a bridge parapet, etc.*

b) Mark out connection between types of safety fence.

c) Mark out flared ends.

d) Mark out anchorages.

COMMENTARY. *This should be done relative to bridge parapet, direction of safety fence or expansion joint anchorage.*

e) Mark out types of posts.

2.4.1.2 ***For driven posts***

a) Establish post centre, referenced from the datum.

COMMENTARY. *Where a non-standard beam is authorized, post centre should be confirmed with the Engineer.*

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Drive post to the specified height.

COMMENTARY. *One method of achieving this is by sighting onto a traveller.*

2.4.1.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawing and the specification for each type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

2.4.1.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centres established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of post faces oncoming traffic.

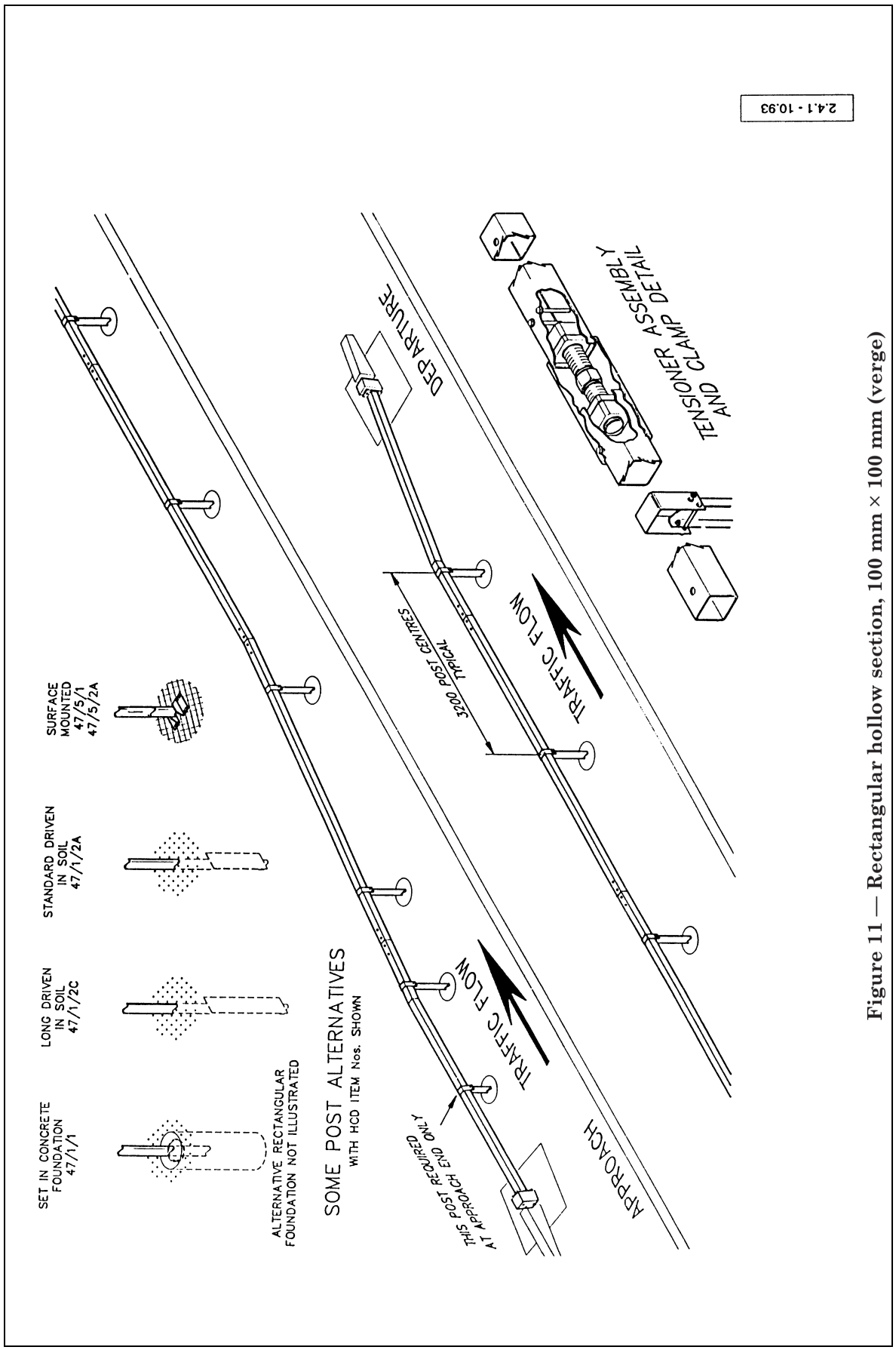


Figure 11 — Rectangular hollow section, 100 mm × 100 mm (verge)

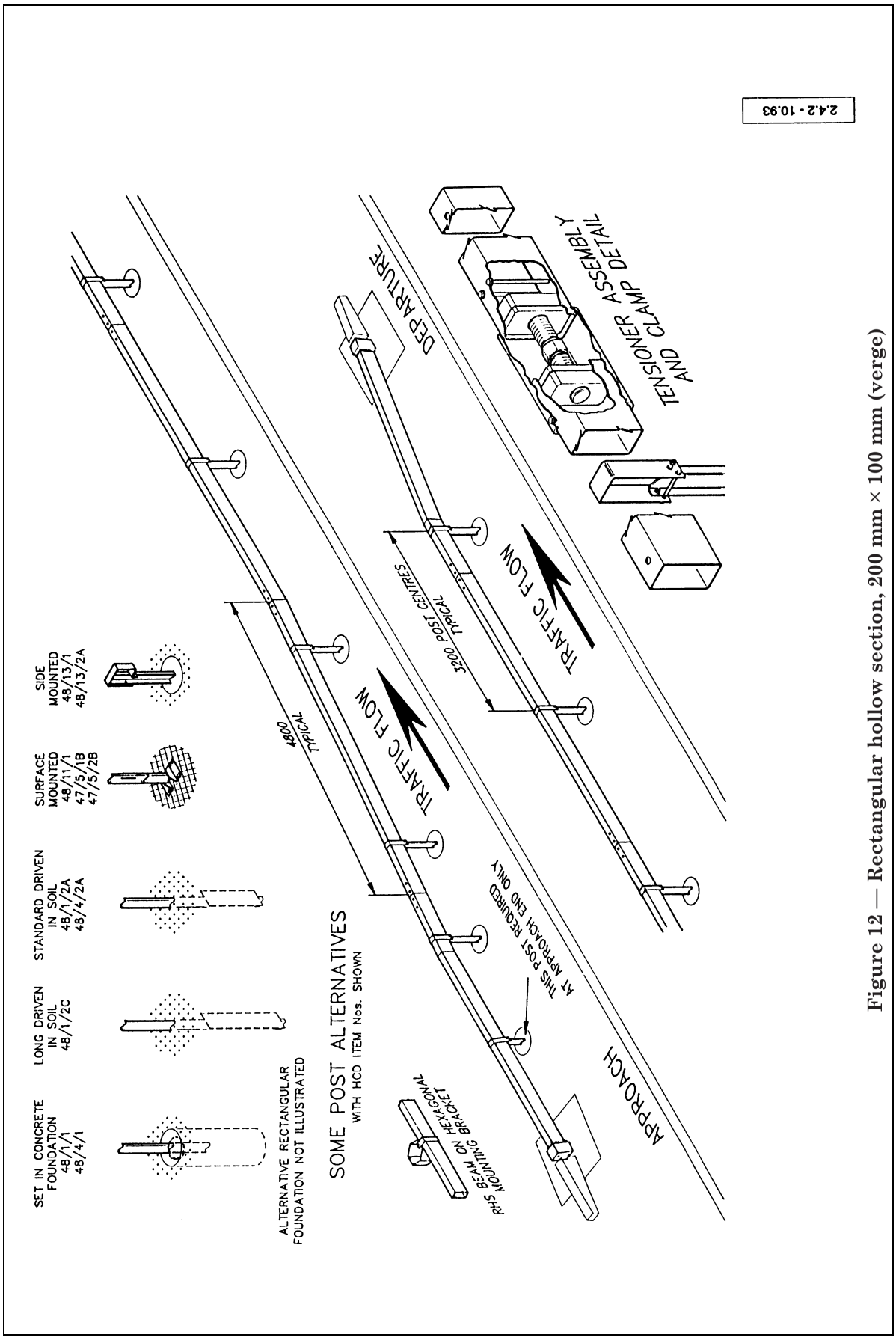


Figure 12 — Rectangular hollow section, 200 mm × 100 mm (verge)

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre. Fit excluder to socketed post.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket.

b) In existing filter drains

i) Excavate for foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.4.1.4** a).

2.4.1.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.4.1.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.4.1.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix the surface-mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.4.1.7 ***Terminal section***

a) Excavate for anchor block. Dispose of excess arisings.

COMMENTARY. *If the terminal is flared, ensure that the specified offsets have been used. Anchorage bolts should have the nuts adjacent to the fairing.*

b) Assemble terminal section and support in correct position.

c) Place concrete, vibrate and compact.

d) Insert reinforcing hooks.

e) Recompact concrete. Slope concrete away from terminal section supports, to prevent formation of corrosion pockets. Finish to level and cure.

f) Place concrete to form fairing to terminal, ensuring that the concrete is flush with both faces of the end post. Concrete fairing should follow slope of end beam.

2.4.1.8 ***Assembly***

a) Position beams adjacent to posts together with tensioning assembly.

COMMENTARY. *Check that beam joints do not coincide with post locations.*

b) Position beams onto posts in separate beam lengths and hold in place using the correct post strap. Locate hand tightened beam connector plates. Continue operation until the whole length is erected.

COMMENTARY. *Check initial setting dimension on tensioner assembly* (158 mm to 162 mm).

Ensure that joints are open as far as connecting bolts will allow.

c) Tighten all connector screws to a torque of 60 N · m to 80 N · m.

2.4.1.9 ***Tensioning***

a) Check that each limit of the length of assembled fence to be tensioned is anchored.

b) Check that the post strap at each post location is loosely assembled.

c) Remove slack at the tensioner assemblies over the whole length.

d) Tighten the anchorage bolts at ramped end anchorages. Ensure that a gap of 25 mm is maintained between the beam and the end post.

e) Starting at the tensioning assembly adjacent to an effective anchorage, tighten turnbuckles to a torque of 700 N · m and check for any movement of the anchorage. Assemblies should be tensioned sequentially anchorage to anchorage.

COMMENTARY. *If movement is observed in the ground anchor the Engineer should immediately be informed.*

f) Tighten all post bolts and strap bolts to a torque of 19 N · m and fit covers to tension assemblies.

2.4.2 Full height anchorages

See **2.1.3** for method of installation.

2.5 Wire rope safety fence (Figure 13)

2.5.1 Wire rope safety fences

2.5.1.1 ***Mark out***

a) Establish datum.

COMMENTARY. *The centre of an outer end anchorage block is usually taken as datum.*

b) Establish end anchor blocks.

c) Establish intermediate anchor blocks.

d) Establish types of posts.

2.5.1.2 ***For driven posts***

a) Establish post centres, referenced from the end anchor block (datum) and intermediate anchor blocks.

b) Establish height datum.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Drive post to the specified height.

COMMENTARY. *This can be achieved by sighting onto a traveller. Measures need to be taken to ensure that the width of the slot at the top of the post is maintained.*

2.5.1.3 ***Concrete foundations***

a) Establish post centre referenced from the datum and excavate foundation. Dispose of excess arisings.

COMMENTARY. *Ensure that the drawings and the specification for type of foundation are as prescribed by the client and confirm whether post is to be placed into a galvanized socket.*

b) Place concrete, vibrate and compact.

c) Ensure that post is the correct type.

d) Ensure that radiused edge of post faces oncoming traffic.

e) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

f) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

g) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket (or fit excluder if specified).

2.5.1.4 ***Filter drain foundations***

a) On new works

i) Place required size formwork in trench at post centre established from the datum.

COMMENTARY. *Prior to this operation, the trench should be filled with filter material to a depth not less than the underside of the foundation. In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

ii) Where trench overbreak and/or non-verticality of trench side occur, a method to overcome this problem should be agreed with the Engineer.

iii) Place remainder of filter material in the trench.

iv) Place concrete into formwork.

COMMENTARY. *Ensure that filter drain remains uncontaminated.*

v) Vibrate and compact concrete and withdraw formwork.

COMMENTARY. *Some types of formwork may be left in-situ.*

vi) Ensure that post is the correct type.

vii) Ensure that radiused edge of the post faces oncoming traffic.

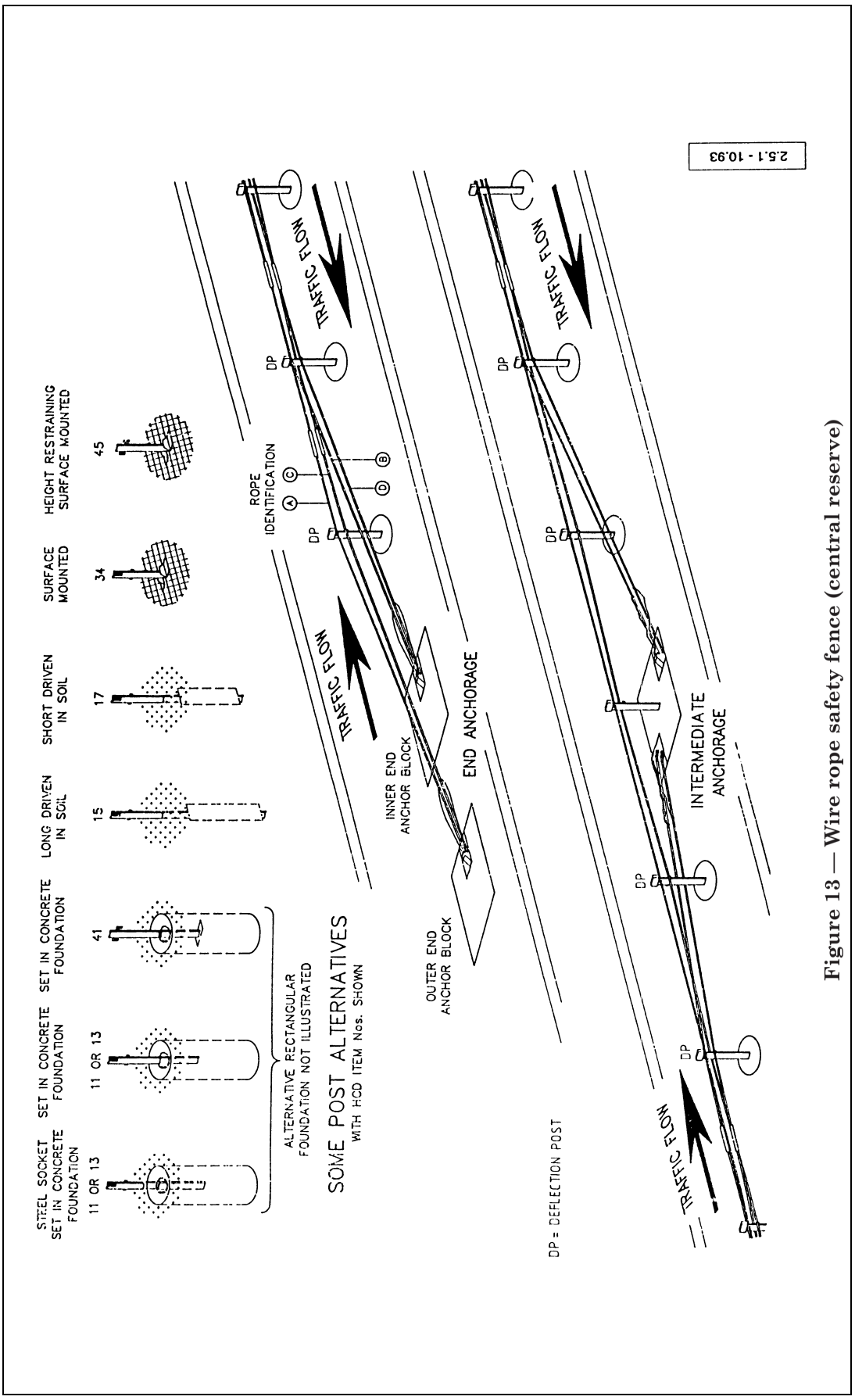


Figure 13 — Wire rope safety fence (central reserve)

viii) Set post and/or socket and reinforcing ring in wet concrete to the specified height, set-back and post centre.

COMMENTARY. *Ensure that post and/or socket and reinforcing ring remain in the correct position.*

ix) Recompact concrete. Slope concrete away from post/socket to prevent formation of corrosion pockets. Finish to level and cure.

x) Install post in socket and fill void with a non-setting passive filler to a level slightly above the top of the socket (or fit excluder if specified).

b) In existing filter drains

i) Excavate for foundations at post centres established from the datum.

COMMENTARY. *A mechanical excavator may be used.*

ii) Save existing filter material from excavated fill material for re-use where appropriate. Dispose of excess arisings.

iii) Place required formwork at post locations and backfill.

COMMENTARY. *In order to contain the concrete, a suitable membrane should line the base of the concrete foundation.*

iv) Continue as described in iv) to x) of **2.5.1.4** a).

2.5.1.5 ***For demountable post foundations***

Construct foundations and erect posts as described in **2.5.1.3**.

COMMENTARY. *Foundations may be provided by coring in full depth road construction.*

2.5.1.6 ***Surface-mounted posts***

a) Establish post centre, referenced from the datum.

b) Establish position of anchorage and attachment systems.

COMMENTARY. *If diamond drilling is required, refer to the manufacturer's instructions for installation. If necessary, locate reinforcement utilizing a cover meter. If reinforcement has to be drilled seek the agreement of the Engineer.*

c) Select drill bit of correct diameter and type.

d) Drill the hole to the correct depth.

COMMENTARY. *Belling out at the top of the hole is to be avoided.*

e) Flush clean the hole.

COMMENTARY. *This may be done with compressed air or water.*

f) Install the anchorage and attachment system.

COMMENTARY. *The anchorage and attachment system should be used in accordance with the manufacturer's instructions.*

g) Ensure that post is the correct type.

h) Ensure that radiused edge of post faces oncoming traffic.

i) Fix the surface mounted post to the specified height.

j) Tighten the attachment system to the manufacturer's specified torque and minimum thread engagement.

COMMENTARY.

i) A mortar bed of between 10 mm *and* 30 mm *should be placed under a surface-mounted post unless it is attached to a steel base.*

ii) All voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

2.5.1.7 ***Anchors: end/intermediate anchor blocks***

a) Excavate for anchor blocks. Dispose of excess arisings.

COMMENTARY. *Ensure that the specified offsets have been used.*

b) Insert anchor frame.

c) Place concrete, vibrate and compact.

d) Finish to level and cure.

2.5.1.8 ***Assembly***

a) Support reel of rope on a suitable reel carrier.

b) Attach safety check rope to tail rope and tail rope to anchor frame using washer and nut. Connect safety check rope to anchor frame.

COMMENTARY. *Start with lower "D" rope on the inner end anchor block at the datum as stated on the reeling list provided by the supplier of the safety fence.*

c) Move reel carrier down fence line, paying out the rope from the reel until the point where a rigging screw connection is required.

d) Connect the paid out length of rope to the next length of rope on the reel, using a rigging screw.

COMMENTARY. *A length of approximately* 10 mm *of each terminal end should be inserted in end of the rigging screw.*

e) Continue down the fence line connecting all the ropes in a similar manner until the next anchor block. Attach safety check rope to tail rope and tail rope to anchor frame using washer and nuts. Connect safety check rope to anchor frame.

f) If this anchor is an intermediate anchor, proceed until the end anchor is reached.

g) Attach safety check rope to the final tail rope and the final tail rope to anchor frame using washer and nuts. Connect safety check rope to anchor frame.

h) After the "D" ropes have been connected to all anchor points, interweave between posts, locating the rope on the locating pegs.

i) Return the reel carrier to the start of the next rope.

j) Repeat a) to i) for rope "C", starting on the outer end anchor.

k) Repeat a) to g) for rope "B", starting on the inner end anchor.

l) Rope "B" is placed in the slots in the top of the posts.

m) Repeat a) to g) for rope "A", starting on the outer end anchor.

n) Rope (A) is placed in the slots in the top of the posts.

o) Place caps on tops of posts.

p) Remove slack in safety check rope by clipping it to the tail rope using suitable plastic clips.

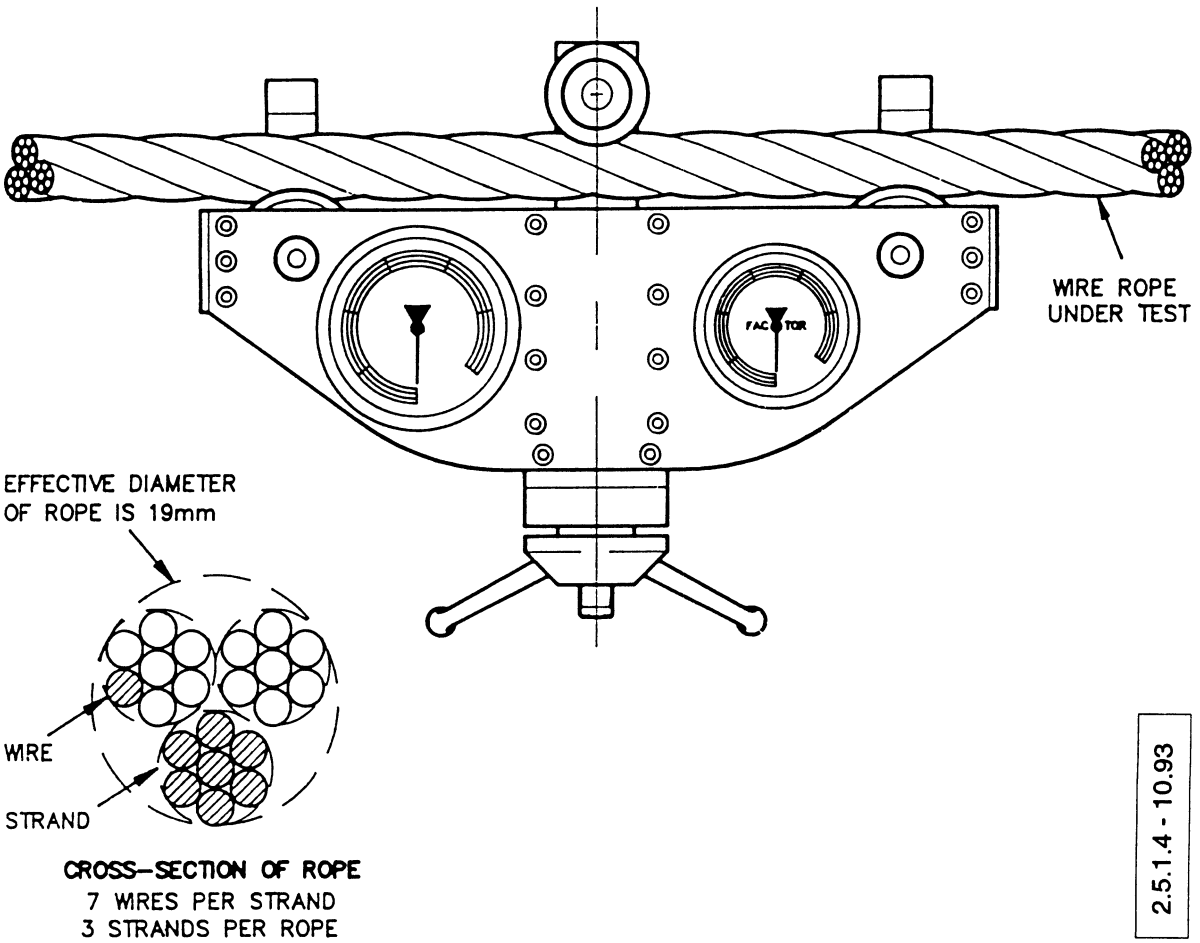


Figure 14 — Wire rope tension meter

COMMENTARY.

i) The removal of slack avoids the safety check rope causing a hazard to personnel.

ii) If any movement is observed in the ground anchorages, the Engineer should immediately be informed.

Table 3 — Tension for wire rope safety fence

Ambient temperature °C	**Rope tension** kN
30	14.0
25	16.75
20	19.5
15	22.25
10	25.0
5	27.75
0	30.5
– 5	33.25
– 10	36.0

COMMENTARY on Table 3.

i) Regular checks should be made on the ambient air temperature and the value of tension adjusted as appropriate.

ii)Interpolation of values is allowed.

iii) Ensure that at least 25 mm *thread is in each end of the rigging screws.*

iv)Tensioning should not be undertaken outside the 30 °C *to* – 10 °C *range.*

2.5.1.9 *Tensioning*

a) Ensure that terminal ends are securely placed in the anchor frames.

COMMENTARY. *Temporary packing in the anchor frame pocket should ensure that there is no accidental displacement of the terminal ends during the tensioning process.*

b) Ensure that all rigging screws have a minimum thread engagement of 10 mm.

c) Ensure that lower ropes are weaved correctly and are placed on the appropriate deflection posts.

d) Ensure that the upper ropes are in the slots of the posts and are led to the anchor frame from the correct deflection post.

e) Commence tensioning at the rigging screws nearest to one end anchor. Select one of the ropes and using a calibrated tension meter on the same rope in the adjacent bay, tighten the rigging screw until the rope is at the tension specified for the ambient temperature as given in Table 3. Recheck that rigging screw/terminal ends have a minimum thread engagement of 25 m.

COMMENTARY. *The two terminal ends should be held steady with spanners whilst the rigging screw is rotated.*

f) Repeat for the other three ropes at this location.

g) Proceed along the fence to each group of rigging screws and reapt item e).

h) Remove all packing from end and intermediate anchor blocks.

i) Check for any movement in the anchor blocks and deflection posts.

COMMENTARY. *If any movement is observed in any of the foundations, the Engineer should be immediately informed.*

Section 3. User guide to inspection of new and in-service safety fences

NOTE References to drawings, e.g. GA/11, that are published in the *Manual of Contract Documents for Highway Works,* Volume 3, *Highway Construction Details* (Section **2**)[8] are included in this section and are listed in Annex C.

3.1 General

3.1.1 This section:

a) clarifies procedures for checking "new" and "in-service" safety fences;

b) sets out guidelines for recording and upgrading those safety fences which have been previously inspected but have not been checked for compliance with present day standards.

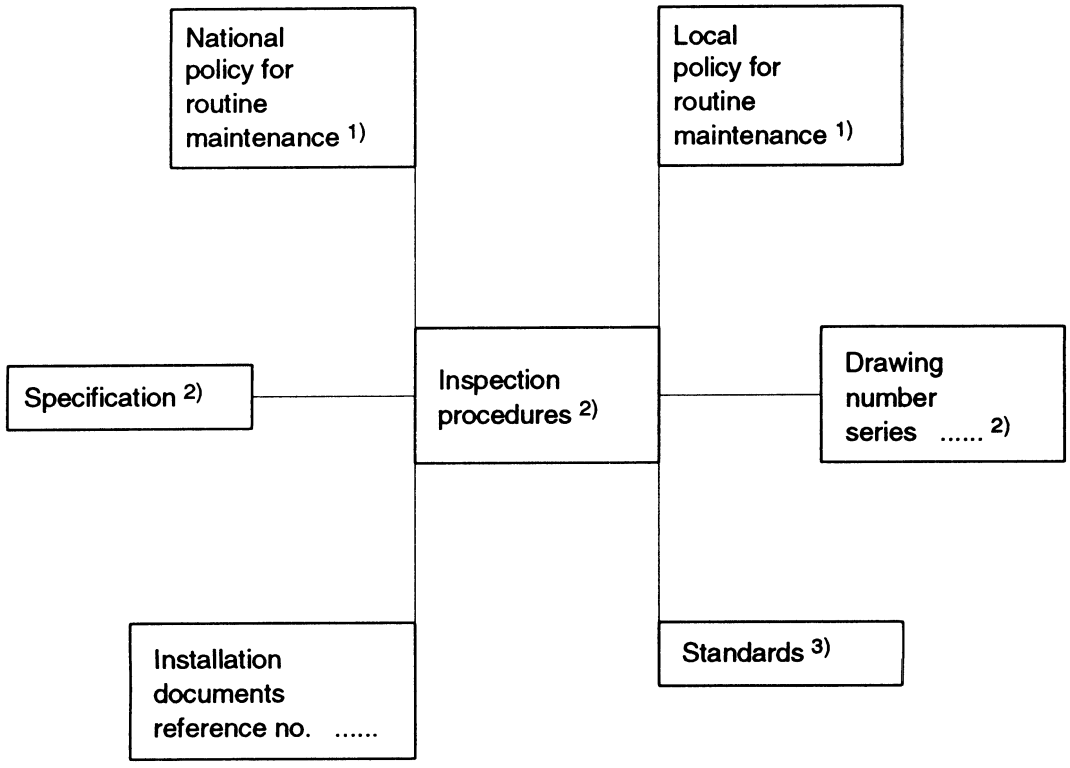
3.1.2 Reference should also be made to approved practices such as national or locally adopted policies for routine maintenance, specifications, drawings and standards as shown in Figure 15.

3.2 Procedure for adding existing safety fences to an inspection programme

3.2.1 This section identifies three areas of safety fencing that require different treatment before they are added to a programme of planned inspection and maintenance. This programme should be in accordance with Figure 16.

3.2.2 The Highway Authority should identify all safety fences in an inventory system or Routine Maintenance Management System (RMMS). This should include road numbers, the speed limit, the length and type of fence together with a description of the location, e.g. left hand/right hand verge or central reserve, which may involve a grid reference number, so that the location of any defect can be properly communicated to the repairer.

3.2.3 For wire rope safety fences, the "as-erected" reeling list should be archived within the inventory system.

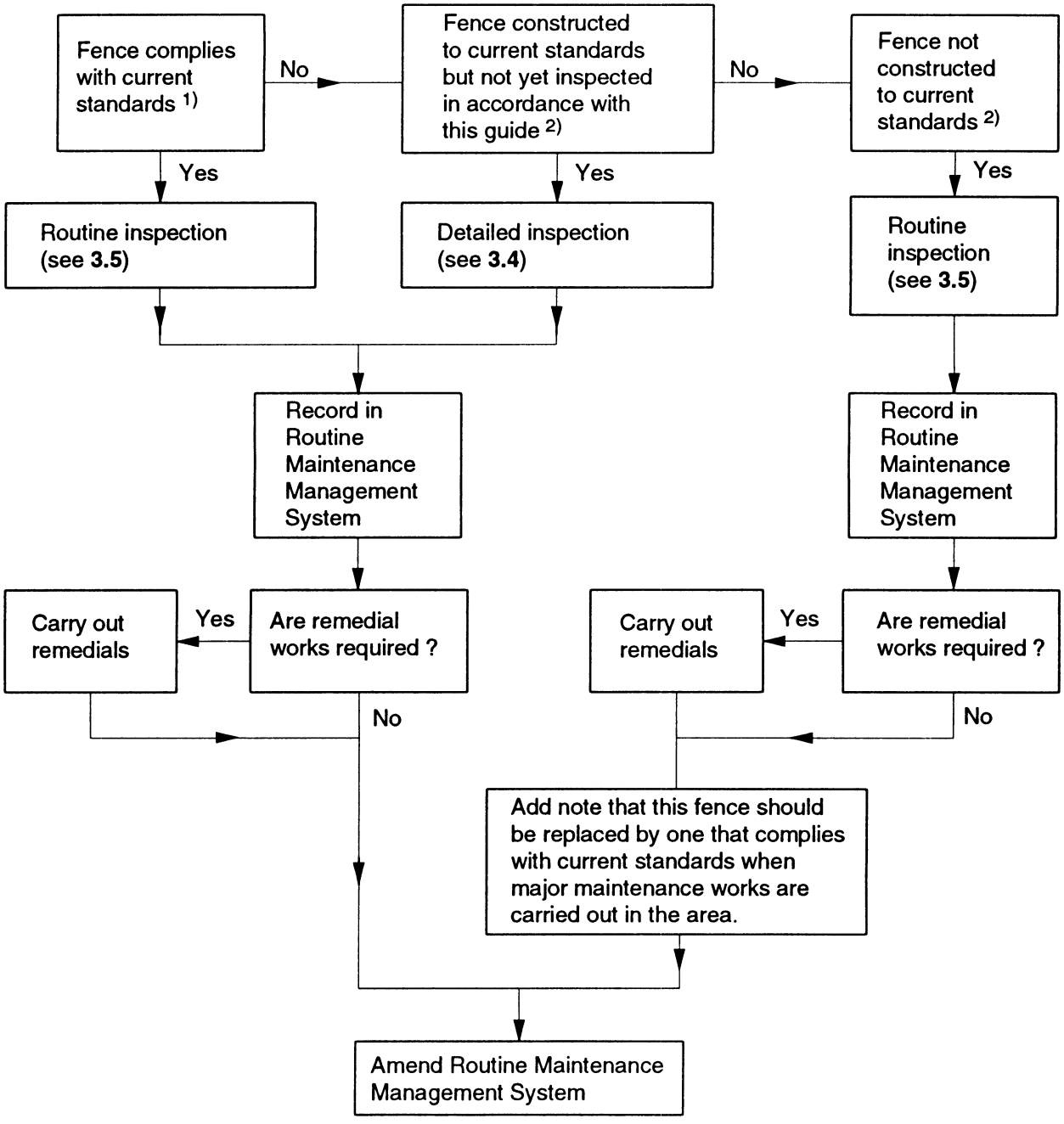


1) e.g. *Trunk Road Maintenance Manual,* Volume 2[9] or *Highway Maintenance: A Code of Good Practice*[10].

2) e.g. *Manual of Contract Documents for Highway Works*, [8], [11].

3) e.g. national standards.

Figure 15 — Inspection procedures in relation to approved practices



1) e.g. Post-1988 and erected and supervised under a quality assurance scheme;

2) e.g. See TD 19/85[13].

Figure 16 — Planned inspection and maintenance flow chart

3.3 Routine inspection programme

3.3.1 Inspection personnel

All inspection personnel should be responsible and competent for the task, should receive adequate training and should be fully conversant with the relevant inspection procedure and safety requirements. The requirements for inspections (e.g. *Trunk Road Maintenance Manual,* Volume 2[9] or *Highway Maintenance: A Code of Good Practice*[10]) should cover, as a minimum, both safety and detailed inspections.

3.3.2 Safety inspections

The safety inspections are designed to identify those defects likely to create a danger or serious inconvenience to the public and which therefore require immediate or urgent attention. They may be mobile inspections from a slow-moving vehicle but will more likely be carried out on foot particularly in busy urban areas. Additional safety inspections may be required in response to reports of complaints from the police, other authorities and organizations, and the public; as a result of major incidents; or as a result of extreme adverse weather conditions.

3.3.3 Detailed inspections

The detailed inspections are carried out at less frequent intervals than safety inspections and are designed to establish a programme for routine maintenance tasks not requiring urgent execution.

3.3.4 Frequency of safety inspections

Frequency of safety inspections should be in accordance with Figure 17.

3.3.5 Requirements for safety inspections

Whenever possible, safety inspections should be integrated with the activities of trained maintenance personnel. In this way any defects encountered which constitute an imminent hazard to the public can be corrected, made safe, or otherwise protected at the time of discovery. As a normal minimum, the aim should be to warn motorists of the hazard before reporting to the base office at the earliest opportunity with a request for immediate action.

3.3.6 Report form

The report form (see Figure 18) should include a record of the action taken and should be deposited at the base office within 24 h where it should be properly recorded and retained for 6 years. All reports and complaints received should be similarly recorded and retained together with details of specific inspections and action taken.

3.3.7 Frequency of detailed inspections

Frequency of detailed inspections should be in accordance with Figure 19.

3.3.8 Requirements for detailed inspections

Detailed inspections should be carried out with the aid of the relevant check list using a paper based system or an approved computer data capture system. Report forms should be completed as far as possible at the time of the inspection and deposited at the base office where they should, if necessary, be fully completed before being properly recorded and retained for a minimum of 6 years. A number of Highway Authorities will be using data capture devices instead of report forms and it is important that the associated computer systems are programmed to produce the necessary data bases which can be properly archived.

3.3.9 Requirements for maintenance

Requirements for maintenance should be specified and an example may be found in the *Trunk Road Maintenance Manual,* Volume 2[9].

3.4 Detailed inspection programme

Suitable methods are described for checking safety fences in relation to present day standards.

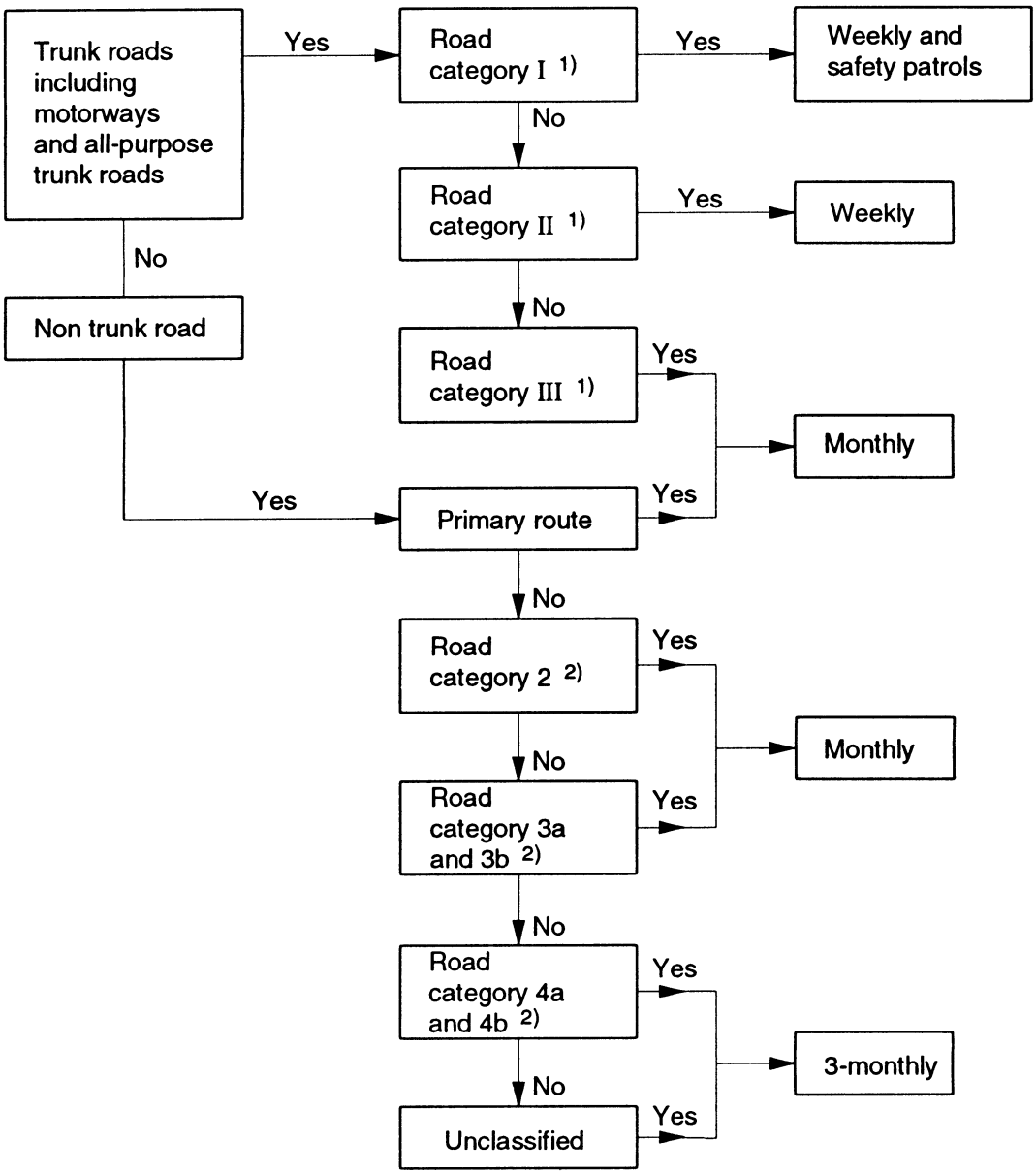
Figure 20 is a questionnaire form providing a method for a detailed inspection of a tensioned corrugated beam safety fence.

Figure 21 is a questionnaire form providing a method for a detailed inspection of an untensioned corrugated beam safety fence.

Figure 22 is a questionnaire form providing a method for a detailed inspection of an open box beam safety fence.

Figure 23 is a questionnaire form providing a method for a detailed inspection of a tensioned rectangular hollow section safety fence.

Figure 24 is a questionnaire form providing a method for a detailed inspection of a wire rope safety fence.



1) *Trunk Road Maintenance Manual*, Volume 2[9].

2) *Highway Maintenance: A Code of Good Practice*[10].

Figure 17 — Frequency of safety inspections

Inspection of safety fences
Routine inspection report

Authority .....

Date visit due ..... Date inspected ..... By .....

Fence number ..... Road number..... Division ..... Grid reference .....

Location ..... Speed limit of road..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

Comments on last inspection

Location	*Defect*	*Category*
Example		
Beam 36	Galvanizing scored	—

Comments on this inspection

(The whole installation is assumed to be in good condition unless stated below:)

Location	*Defect*	*Category*
Beam 24	Lap screw missing	1
Beams 31 to 34	Accident damage	1
Beam 36	Galvanizing scored	—
Beam 43	Single post bent — bolt missing	2

Check list

Posts: Orientation, damage, corrosion, stability, fixings to beam

Beams: Damage, corrosion (see note 2), lap screws, adjuster assembly

General: Anchorages, concrete fairing, connection pieces, angle beam, mounting brackets

Has any work taken place since the last inspection which may have affected the mounting height, set-back or clearance to the safety fence?

NOTE 1 Category 1 defects require prompt attention because they represent an immediate hazard. Category 2 defects can be left for up to 6 months before repairs need to be effected.
NOTE 2 With regard to corrosion, discolouration of the surface should not make a component unserviceable but loose rust or pitting does.

Figure 18 — Example of a routine inspection form

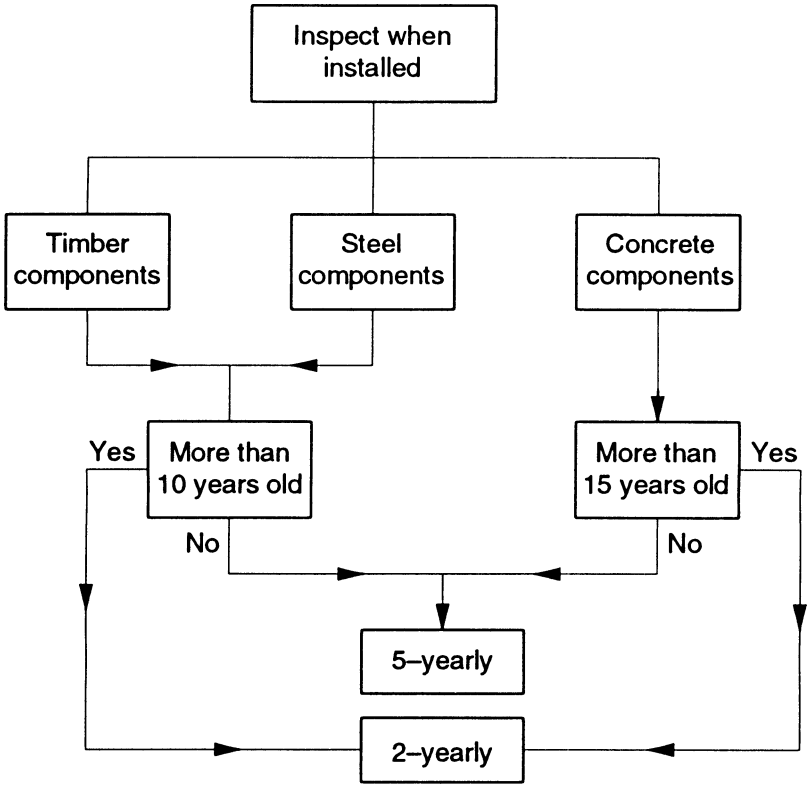


Figure 19 — Frequency of detailed inspections

Authority .....

Date visit due ..... Date inspected ..... By .....

Reference number ..... Road number ..... Division .....

Grid reference ..... Location ..... Speed limit of road ..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

If the answer to any of the following is 'No', provide full details.

	Yes	If 'No', state location and comments
1. General		
a) Is the set-back within specification? (See **3.5.2** and figures 25 and 26)		
b) Is the clearance behind the fence within specification? (See **3.5.2**, figures 25, 26 and table 4		
c) Are the mounting heights of each beam within tolerance? (See **3.5.1**, and figure 1		
d) Is the whole installation free from any missing posts, bolts, screws or other components?		
e) Is the whole installation free of any corrosion which may affect the integrity of the fence?		
f) Does the whole installation have a generally satisfactory flowing alignment?		
g) Is the ground profile in front of and behind the safety fence (in the clearance zone) generally level and free from obstacles, including redundant fence fixings, e.g. fairings and end posts?		
2. Anchorages, terminals etc.		
a) Is the concrete fairing of the correct dimension? (See GA/11)		
b) Is the fairing on the approach end flush with or in front of the traffic face of the fence?		
c) Is the fairing on the departure end flush with or behind the traffic face of the fence?		
d) Is the approach flare to standard specifications? (See GA/13)		

Figure 20 — Questionnaire form for a detailed inspection of a tensioned corrugated beam safety fence

	Yes	If 'No', state location and comments
e) On the approach end has an intermediate post been erected between the anchor block and the angle beam post? (See GA/13)		
f) Is the angle beam post correct, i.e. with concrete foundation and with 12 mm diameter shear bolt to beam? (See GA/12)		
g) Is the angle beam either welded on both sides or formed without welds? (Beams welded on one side only are no longer acceptable)		
h) Is the mass concrete anchor block secure and of the correct dimensions with the anchorage or post correctly orientated?		
i) Have the anchor bolts been assembled and tensioned correctly and is there 80 mm clearance to the concrete fairing where applicable?		
j) At full height anchorages, is the frame securely bolted to the concrete base?		
k) Is the terminal section connection to other type of safety fence or connection to bridge parapet secure?		
3. Posts		
a) Are the posts at the correct spacing? (See **3.5.3.1**)		
b) Where posts are required at half standard spacing, does the zone of half post spacing extend in front of and beyond the obstruction? (See **3.5.3.1**)		
c) Are the post foundations secure? (See **3.5.4**)		
d) Where surface-mounted posts are used, are the anchor bolts secure and in satisfactory condition?		
e) Are the post beddings sound?		
f) Are the voids for the socketted posts suitably filled?		
g) Is the top of each concrete foundation less than 75 mm above ground level?		
h) Are the posts correctly orientated, i.e. with radiused edge of post presented to direction of traffic flow?		
i) Has each post been positioned so that the post screw is not hard against the end of its slot in the beam?		
j) Are the posts in a satisfactory condition?		
k) Do the record (as constructed) drawings show the locations where posts extension pieces have been used?		
l) Have the correct post extension pieces been used?		

Figure 20 — Questionnaire form for a detailed inspection of tensioned corrugated beam safety fence *(continued)*

	Yes	If 'No', state location and comments
4. Beams		
a) Do the beams overlap in the correct direction? (See GA/13)		
b) On standard beams have the correct size of post screws been used and assembled correctly? (See GA/12)		
c) Are the post screws tight? Check at least one bolt in every 20 for 18 N·m to 20 N·m torque.		
d) Has the slack been removed from each lap joint?		
e) Are the lap screws assembled correctly with connecting straps if double sided beam is used? (See GA/11)		
f) Are the lap screws tight? Check at least one bolt in every 20 lap joints for 60 N·m to 80 N·m torque?		
g) Is the antiglare fencing in good order?		
h) Are the beams in a satisfactory condition?		
5. Adjuster assemblies		
a) Are the adjuster assemblies at the correct spacing, i.e. not more than 70.5 m apart?		
b) Are the adjuster brackets correctly orientated, i.e. with the thicker end wall against the nut or bolt head? (See GA/11)		
c) Do the adjuster beams lap in the correct direction and by more than 50 mm? (See GA/11)		
d) Are the pairs of adjuster bolts sufficiently tight such that they will resist rotation by hand within the bracket?		
e) Are the lock nuts fitted and tightened on all the adjuster bolts?		
f) On double sided tensioned corrugated beam are the adjuster assemblies opposite each other?		

Figure 20 — Questionnaire form for a detailed inspection of tensioned corrugated beam safety fence *(concluded)*

Authority .....

Date visit due ..... Date inspected ..... By .....

Reference number ..... Road number ..... Division .....

Grid reference ..... Location ..... Speed limit of road ..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

If the answer to any of the following is 'No', provide full details.

	Yes	If 'No', state location and comments
1. General		
a) Is the set-back within specification? (See **3.5.2** and figures 25 and 26)		
b) Is the clearance behind the fence within specification? (See **3.5.2**, figures 25, 26 and table 4		
c) Are the mounting heights of each beam within tolerance? (See **3.5.1**, and figure 1)		
d) Is the whole installation free from any missing posts, bolts, screws or other components?		
e) Is the whole installation free of any corrosion which may affect the integrity of the fence?		
f) Does the whole installation have a generally satisfactory flowing alignment?		
g) Is the ground profile in front of and behind the safety fence (in the clearance zone) generally level and free from obstacles, including redundant fence fixings, e.g. fairings and end posts?		
2. Anchorages, terminals etc.		
a) Is the approach flare to standard specification? (See GA/19)		
b) Is the angle beam either welded on both sides or formed without welds (for fences made to a pre-1992 specification)? (Beams welded on one side only are no longer acceptable)		
c) Is the end of the fence protected with ramping up of granular material?		
d) Is the terminal section connection to other type of safety fence or connection to bridge parapet secure?		

Figure 21 — Questionnaire form for a detailed inspection of an untensioned corrugated beam safety fence

	Yes	If 'No', state location and comments
3. Posts		
a) Are the posts at the correct spacing? (See **3.5.3.2**)		
b) Are the post foundations secure? (See **3.5.4**)		
c) Is the top of each concrete foundation less than 75 mm above ground level?		
d) Are the posts correctly orientated, i.e. with radiused edge of post presented to direction of traffic flow?		
e) Are the post beddings sound?		
f) Where surface-mounted posts are used, are the anchor bolts secure and in satisfactory condition?		
g) Are the voids for the socketted posts suitably filled?		
h) Are posts in a satisfactory condition?		
i) Do the record drawings show the locations where post extension pieces have been used?		
j) Have the correct post extension pieces been used?		
4. Beams		
a) Do the beams overlap in the correct direction? (See GA/18 and GA/19)		
b) On standard beams, have the correct size of post screws been used and assembled correctly? (See GA/19)		
c) Is the antiglare fencing in good order?		
d) Are the beams in a satisfactory condition?		

Figure 21 — Questionnaire form for a detailed inspection of an untensioned corrugated beam safety fence *(concluded)*

Authority .....

Date visit due ..... Date inspected ..... By .....

Reference number ..... Road number ..... Division .....

Grid reference ..... Location ..... Speed limit of road ..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

If the answer to any of the following is 'No', provide full details.

	Yes	If 'No', state location and comments
1. General		
a) Is the set-back within specification? (See **3.5.2** and figures 25 and 26)		
b) Is the clearance behind the fence within specification? (See **3.5.2**, figures 25, 26 and table 4)		
c) Are the mounting heights of each beam within tolerance? (See **3.5.1**, and figure 1)		
d) Is the whole installation free from any missing posts, bolts, screws or other components?		
e) Is the whole installation free of any corrosion which may affect the integrity of the fence? (Including interaction between the steel and aluminium parapets)		
f) Does the whole installation have a generally satisfactory flowing alignment?		
g) Is the ground profile in front of and behind the safety fence (in the clearance zone) generally level and free from obstacles, including redundant fence fixings, e.g. fairings and end posts?		
2. Anchorages, terminals etc.		
a) Is the concrete fairing of the correct dimensions? (See GA/20, GA/22, GA/23 and GA/24)		
b) Is the fairing on the approach end flush with or in front of the traffic face of the fence?		
c) Is the fairing on the departure end flush with or behind the traffic face of the fence?		
d) Is the approach flare to standard specification? (See GA/22)		
e) Is the angle beam post correct, i.e. with 6 mm diameter hole at top, concrete foundation and with 16 mm diameter bolt to beam? (For fences made to a pre-1992 specification)		
f) Is the mass concrete anchor block secure and of the minimum dimensions with the anchorage or post correctly orientated?		

Figure 22 — Questionnaire form for a detailed inspection of an open box beam safety fence

	Yes	If 'No', state location and comments
g) Where tensioned corrugated beam fence connects to open box beam without a full height anchor, does the length of open box beam exceed 30 m?		
h) At full height anchorages, is the frame securely bolted to the concrete base?		
i) Is the terminal section connection to other type of safety fence or connection to bridge parapet secure?		
3. Posts		
a) Are the posts at the correct spacing? (See **3.5.3.3**)		
b) Where posts are required at half standard spacing, does the zone of half post spacing extend in front of and beyond the obstruction? (See **3.5.3.3**)		
c) Are the post foundations secure? (See **3.5.4**)		
d) Is the top of each concrete foundation less than 75 mm above ground level?		
e) Are the posts correctly orientated, i.e. with radiused edge of post presented to direction of traffic flow?		
f Where surface-mounted posts are used, are the anchor bolts secure and in satisfactory condition?		
g) Are the post beddings sound?		
h) Are the posts in a satisfactory condition?		
i) Do the record drawings show the locations where the post extension pieces have been used?		
j) Are the voids for the socketted posts suitably filled?		
k) Have the correct post extension pieces been used?		
4. Beams		
a) Are the ends of the beams flush at each joint?		
b) Are all bolts tight? Check at least one bolt in every 20 for a torque of 60 N·m to 80 N·m		
c) Where spacers are used on double sided fence (e.g. where there are lighting columns), have stiffeners been inserted midway between posts? (See GA/24 and GA/25)		
d) Where hexagonal brackets are used to mount fencing on structures, are they securely mounted, at half standard spacing and of 6 mm thick steel?		
e) Where hexagonal brackets at standard spacing are used on noise barriers, are they securely mounted and of 8 mm thick steel?		
f) On lengths exceeding 100 m, are expansion beam assemblies fitted at intervals of not more than 100 m?		
g) Is the antiglare fencing in good order?		
h) Are the beams in a satisfactory condition?		

Figure 22 — Questionnaire form for a detailed inspection of an open box beam safety fence *(concluded)*

Authority .....

Date visit due ..... Date inspected ..... By .....

Reference number ..... Road number ..... Division .....

Grid reference ..... Location ..... Speed limit of road ..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

If the answer to any of the following is 'No', provide full details.

	Yes	If 'No', state location and comments
1. General		
a) Is the set-back within specification? (See **3.5.2** and figures 25 and 26)		
b) Is the clearance behind the fence within specification? (See **3.5.2**, figures 25, 26 and table 4)		
c) Are the mounting heights of each beam within tolerance? (See **3.5.1**, and figure 1)		
d) Is the whole installation free from any missing posts, bolts, screws or other components?		
e) Is the whole installation free of any corrosion which may affect the integrity of the fence?		
f) Does the whole installation have a generally satisfactory flowing alignment?		
g) Is the ground profile in front of and behind the safety fence (in the clearance zone) generally level and free from obstacles, including redundant fence fixings, e.g. fairings and end posts?		
h) Where the 100 mm × 100 mm section is used, is the ground surface on which it is situated hardened?		
2. Anchorages, terminals etc.		
a) Is the concrete fairing of the correct dimensions? (See RHS 47/1 for 100 mm × 100 mm section and RHS 48/1 for 200 mm × 100 mm section)		
b) Is the fairing on the departure end flush with or behind the traffic face of the fence?		
c) Is the fairing on the approach end flush with or in front of the traffic face of the fence?		
d) Is the approach flare to standard specification? (See RHS 47/1 for 100 mm × 100 mm section and RHS 48/1 for 200 mm × 100 mm)		
e) On the approach end to the 100 mm × 100 mm section fence, has an intermediate post been erected between the anchor block and the angled beam post? (See RHS 47/1)		
f) Is the angled beam post set in a concrete foundation?		

Figure 23 — Questionnaire form for a detailed inspection of a tensioned rectangular hollow section safety fence

	Yes	If 'No', state location and comments
g) Is the mass concrete anchor block secure and of the correct dimensions with the anchorage or post correctly orientated?		
h) Have full height anchorages been installed where the fence meets a bridge parapet or at expansion joints?		
i) Have the sleeves been fitted to cover all tensioner assembly gaps?		
j) At full height anchorages, is the frame securely bolted to the concrete base?		
k) Is the terminal section or connection to other type of safety fence secure?		
3. Posts		
a) Are the posts at the correct spacing? (See **3.5.3.4**)		
b) Where posts are required at half standard spacing, does the zone of half post spacing extend in front of and beyond the obstruction? (See **3.5.3.4**)		
c) Are the post foundations secure? (See **3.5.4**)		
d) Is the top of each concrete foundation less than 75 mm above ground level?		
e) Are the posts correctly orientated, i.e. with radiused edge of post presented to direction of traffic flow?		
f) Has each post been positioned so that the rail to post strap does not foul the rail joints		
g) Are the straps correct for the type of post, i.e. verge or central reserve?		
h) Where surface-mounted posts are used, are the anchor bolts secure and in satisfactory condition?		
i) Are the post beddings sound?		
j) Are the voids for the socketted posts suitably filled?		
k) Where hexagonal brackets are used to mount the 200 mm × 100 mm section beam to a structure, are these secure and at 1.2 m centres?		
l) Where the clearance to a structure is between 600 mm and 800 mm, have the larger section posts been used (i.e. 110 mm × 50 mm instead of 100 mm × 32 mm)?		
m) Are the posts in a satisfactory condition?		
n) Do the record drawings show the locations where post extension pieces have been used?		
o) Have the correct post extension pieces been used?		

Figure 23 — Questionnaire form for a detailed inspection of a tensioned rectangular hollow section safety fence *(continued)*

	Yes	If 'No', state location and comments
4. Beams		
a) Are the ends of the beams flush at each joint?		
b) Are the post shear and strap bolts tight? Check at least one bolt in every 20 for 18 N·m to 20 N·m torque		
c) Are the beams in a satisfactory condition?		
5. Tensioner assemblies		
a) Are the tensioner assemblies at the correct spacing, i.e. within 50 m of an anchorage and not exceeding 70 m thereafter?		
b) Are the tension assemblies at 700 N·m torque (between 10 °C and 20 °C)?		
c) Have the covers been fitted over each tensioner assembly?		

Figure 23 — Questionnaire form for a detailed inspection of a tensioned rectangular hollow section safety fence *(concluded)*

Authority .....

Date visit due ..... Date inspected ..... By .....

Reference number ..... Road number ..... Division .....

Grid reference ..... Location ..... Speed limit of road ..... mph
(Marker post/Verge/Central reserve)

Description ..... Length .....

Date of last inspection ..... Date of next inspection .....

If the answer to any of the following is 'No', provide full details.

	Yes	If 'No', state location and comments
1. General		
a) Is the set-back within specification? (See **3.5.2** and figures 25 and 26)		
b) Is the clearance behind the fence within specification? (See **3.5.2**, figures 25, 26 and table 4)		
c) Are the heights of the ropes within tolerance? (See **3.5.1**, and figure 1)		
d) Is the whole installation free from any missing posts, or other components?		
e) Is the whole installation free of any corrosion which may affect the integrity of the fence?		
f) Does the whole installation have a generally satisfactory flowing alignment?		
g) Is the ground profile in front of and behind the safety fence (in the clearance zone) generally level and free from obstacles, including redundant fence fixings, e.g. fairings and end posts?		
2. Posts		
a) Are the posts at the correct spacing? (See **3.5.3**)		
b) Are the post foundations secure? (See **3.5.4**)		
c) Is the top of each concrete foundation less than 75 mm above ground level?		
d) Have all posts in sockets been fitted with plastic excluders or filled with a suitable filler?		
e) Have all posts been fitted with plastic caps?		
f) Have the hooks or bobbin devices been fitted to each intermediate post?		

Figure 24 — Questionnaire form for a detailed inspection of a wire rope safety fence

	Yes	If 'No', state location and comments
g) Are the posts correctly orientated, i.e. with radiused edge of post presented to direction of traffic flow?		
h) Where surface-mounted posts are used, are the anchor bolts secure and in satisfactory condition?		
i) Have deflection posts been installed in the last two post positions before an end anchor and penultimate position before an intermediate anchor?		
j) Are the posts in a satisfactory condition?		
3. Anchorages		
a) Are the anchor blocks secure, of the correct dimensions and finish such that the water does not pond on the anchors (See details WR/06 and WR/09)		
b) Are the intermediate anchors at the correct spacing, i.e. not more than 627 m and not less than 30 m apart?		
c) Are the anchor frames correctly orientated so that:		
i) for tail ropes sloping upwards in relation to adjacent traffic, the anchor plate slots face away from those vehicles?		
ii) the tail ropes lie in correct alignment with the deflection posts?		
iii) the tail ropes do not foul the ground?		
4. Rigging screws		
a) Are the rigging screws at the correct spacing, i.e. not more than 154 m apart?		
b) Have they been installed so that the screws on the upper pair of ropes do not coincide within 2.4 m?		
c) Have they been installed so that the screws on the lower pair of ropes do not coincide within 2.4 m?		
d) Are the rope ends joined to the rigging screws with a thread engaged of not less than 25 mm (i.e. maximum of 150 mm of thread exposed on terminals) and evenly threaded each end?		
5. Ropes		
a) Are the ropes at the correct tension? Recheck if necessary. (See figure 14 and table 3)		
b) Have the ropes been rigged so that one does not cause deflection in another?		
c) Are the ropes free from any damage to strands or coating?		
d) Have the two lower line ropes been interwoven between successive posts and positioned on the location pegs?		
e) Have the two upper line ropes been placed in the slot of each post and not twisted? (i.e. the upper line rope on top should stay on top throughout its length between intermediate anchors)		
f) Have the tail ropes been securely fixed to the anchorages with the washer fitted and lock nuts tightened?		

Figure 24 — Questionnaire form for a detailed inspection of a wire rope safety fence *(continued)*

	Yes	If 'No', state location and comments
g) Is the thread engagement at the anchorage end of the tail rope such that a minimum of two threads show behind the lock nuts and, at a maximum, the terminal does not foul the back of the anchorage frame?		
h) Have the safety check ropes been securely fitted to the anchorage attachment plate with clevis pin and stainless steel split pin?		
i) Is the check rope thimble of the correct size and with the tail rope passed through it?		
j) Have the safety check ropes been fully extended along the tail ropes and clipped to it for tightness?		

Figure 24 — Questionnaire form for a detailed inspection of a wire rope safety fence *(concluded)*

3.5 Other recommendations

3.5.1 Mounting height

3.5.1.1 The mounting height for tensioned corrugated beams, untensioned corrugated beams, open box beams and rectangular hollow sections should be 610 mm ± **30 mm for the erection of new safety fences and 610 mm ± 75 mm for in-service fences.**

3.5.1.2 The mounting height for wire rope should be 585 mm ± **10 mm (centre of the upper pair).**

3.5.1.3 Where the set-back is 1.5 m or less, the height (to the centre of the beam or centre of the upper pair of ropes) should be related to the edge of the paved surface. Elsewhere the height should be measured from the general ground level beneath the face of the beam.

3.5.1.4 The 100 mm × 100 mm rectangular hollow section fence may only be used where the ground surface on which it is situated is hardened.

3.5.2 Set-back and clearance

3.5.2.1 *Set-back*

a) The set-back is the dimension between the traffic faces or safety fences and edge of the trafficked carriageway shown in Figure 25 and Figure 26 and should normally be not less than 1.2 m (or 0.6 m from the back of a hardstrip or hardshoulder on the verge side only). On roads subject to a speed limit of 50 mph or less, the set-back from the edge of the trafficked carriageway may be reduced to 0.6 m.

b) The set-back may be reduced to a minimum of 1 m adjacent to short obstructions, such as bridge piers, and on long structures.

3.5.2.2 *Clearance*

Minimum clearances between the rear of the safety fence beam and fixed objects, as shown in Figure 25 and Figure 26, should be as given in Table 4. The desirable minimum value shown in column 4 of Table 4 should be used wherever possible.

3.5.3 Post spacing

3.5.3.1 *Tensioned corrugated beam*

a) Post spacing should normally be 3.2 m except for the following cases, where it should be 1.6 m:

i) for 10 m in advance of, and 7.5 m beyond, the lighting columns etc., where clearances below desirable minimum have been adopted (see **3.5.2**);

ii) at flared end (see GA/13);

iii) at standard cross-overs (see GA/07);

iv) the seven posts immediately adjacent to connection to open box beams;

v) the first seven posts at approach to a full height anchorage.

3.5.3.2 *Untensioned corrugated beam*

a) Post spacing should normally be 3.2 m except for the following cases where it should be 1.6 m (approximately):

i) at flared end (see GA/19);

ii) for existing installations at approach to full height anchorage prior to parapet.

3.5.3.3 *Open box beam*

a) The post/mounting bracket spacing should be 2.4 m in the following cases:

i) where the clearance is 600 mm and above, including at flared ends;

ii) with clearances of 459 mm to 300 mm on hexagonal brackets to noise barrier posts;

iii) on double sided open box beams bracketed to posts.

b) The post/mounting bracket spacing should be 1.2 m in the following cases:

i) with clearances of 599 mm to 460 mm and for 10 m in advance and 7.5 m after an obstruction;

ii) with clearances of 459 mm to 300 mm on hexagonal brackets to structures;

iii) on double sided open box beams bracketed to posts for 10 m before and 7.5 m after lighting columns.

3.5.2.4 ***Rectangular hollow section***

a) The post spacing should normally be 3.2 m except for the following cases:

i) at the approach end of 100 mm × 100 mm section fence between the anchor post and the second full height post (1.6 m centres);

ii) for 9.6 m in advance and throughout the length of central reserve cross-overs (1.6 m centres);

iii) for 200 mm × 100 mm sections fence mounted on structures by hexagonal energy absorbing brackets (1.2 m centres).

Table 4 — Measurement of clearance from fixed objects to safety fence[a]

Type	Height of beam/ropes centres mm	Post/bracket spacing m	Clearances		Application
			Desirable minimum m	Absolute minimum m	
Tensioned corrugated beam (On knock-down posts)					Verge and central reserve
Single sided	610	3.2	1.20	1.00[b]	
Single sided	610	1.6[c]	1.20	0.60[c]	
Double sided	610	3.2	1.00	0.60	
Double sided	610	1.6	1.00	0.46	
Untensioned corrugated beam (on steel posts)	610	3.2	(1.20)[e]	(0.65)[e]	Verge only on speed restricted roads (50 mph max.)
Open box beam (On knock-down posts)					Verge and central reserve where deflection space is limited, e.g. at bridge piers
Single sided	610	2.4	1.00	0.60	
Single sided	610	1.2	1.00	0.46 (0.33)[de]	
Single sided bracket mounted on pier	610	1.2	0.30	0.30	
Double sided bracketed to posts	610	2.4, 1.2[c]	(0.04)[df]	(0.04)[df]	
Rectangular hollow section (On knock-down posts)					Verge and central reserve
100 mm × 100 mm	610	3.2	1.20	1.00	
200 mm × 100 mm	610	3.2	1.00	0.80	
200 mm × 100 mm mounted on traffic side of post	610	3.2	1.00	0.80	
Wire rope safety fence	585 (top ropes) 490 (lower ropes)	2.4 1.2 1.0		1.5 1.3 1.1	Verge and central reserve

[a] This table is taken from TD 19/85[13] and TD 32/93[12].
[b] It is preferable to use open box beam safety fencing at obstructions when the clearance is less than 1.2 m.
[c] For 10 m in advance of lighting columns and 7.5 m beyond columns.
[d] For use at lighting columns.
[e] Figures in brackets denote values where speed is restricted to 50 miles (80 km/h) or less.
[f] When lighting columns are erected between beams bracketed to posts on 1.8 m central reserve.

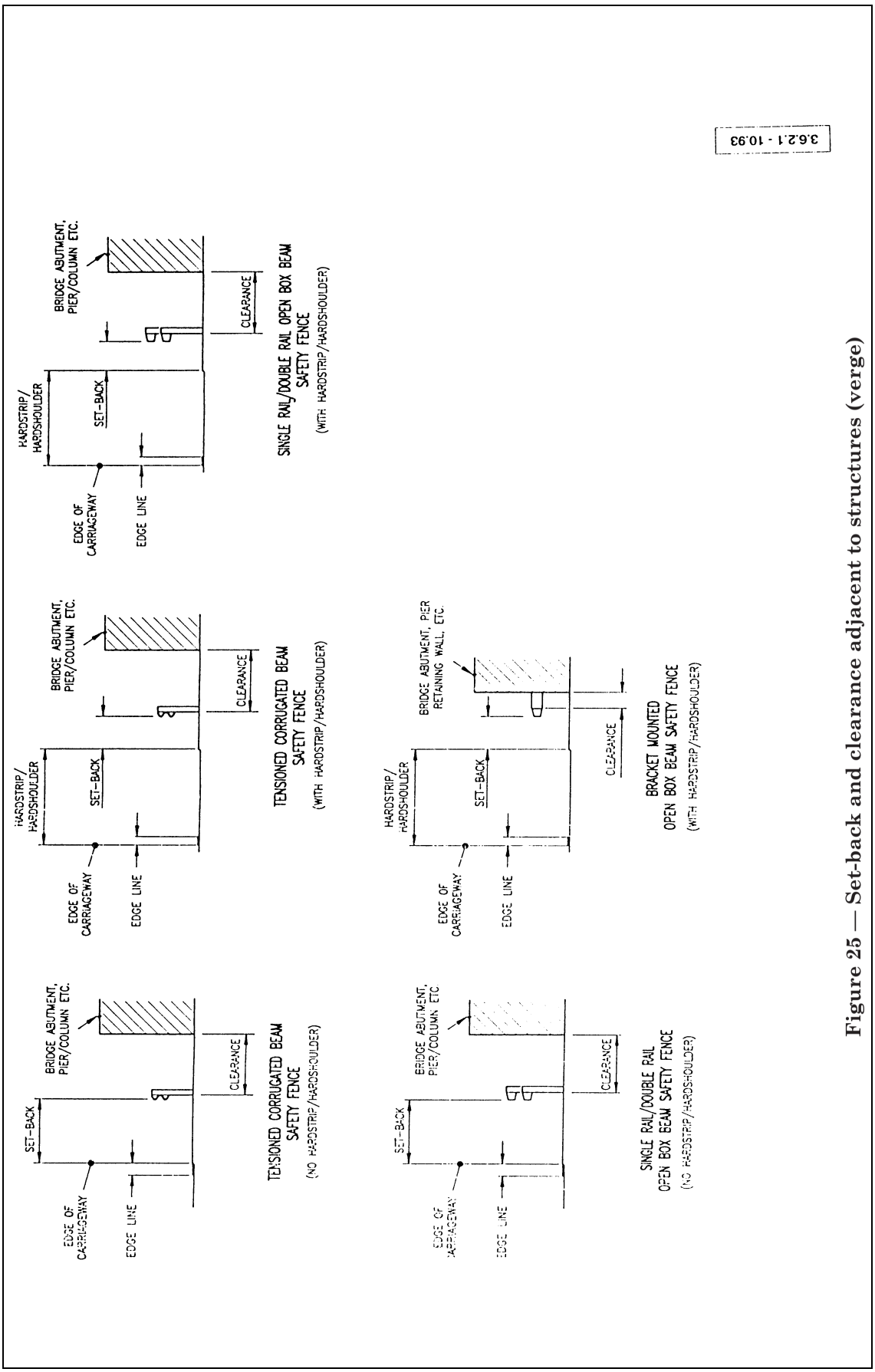


Figure 25 — Set-back and clearance adjacent to structures (verge)

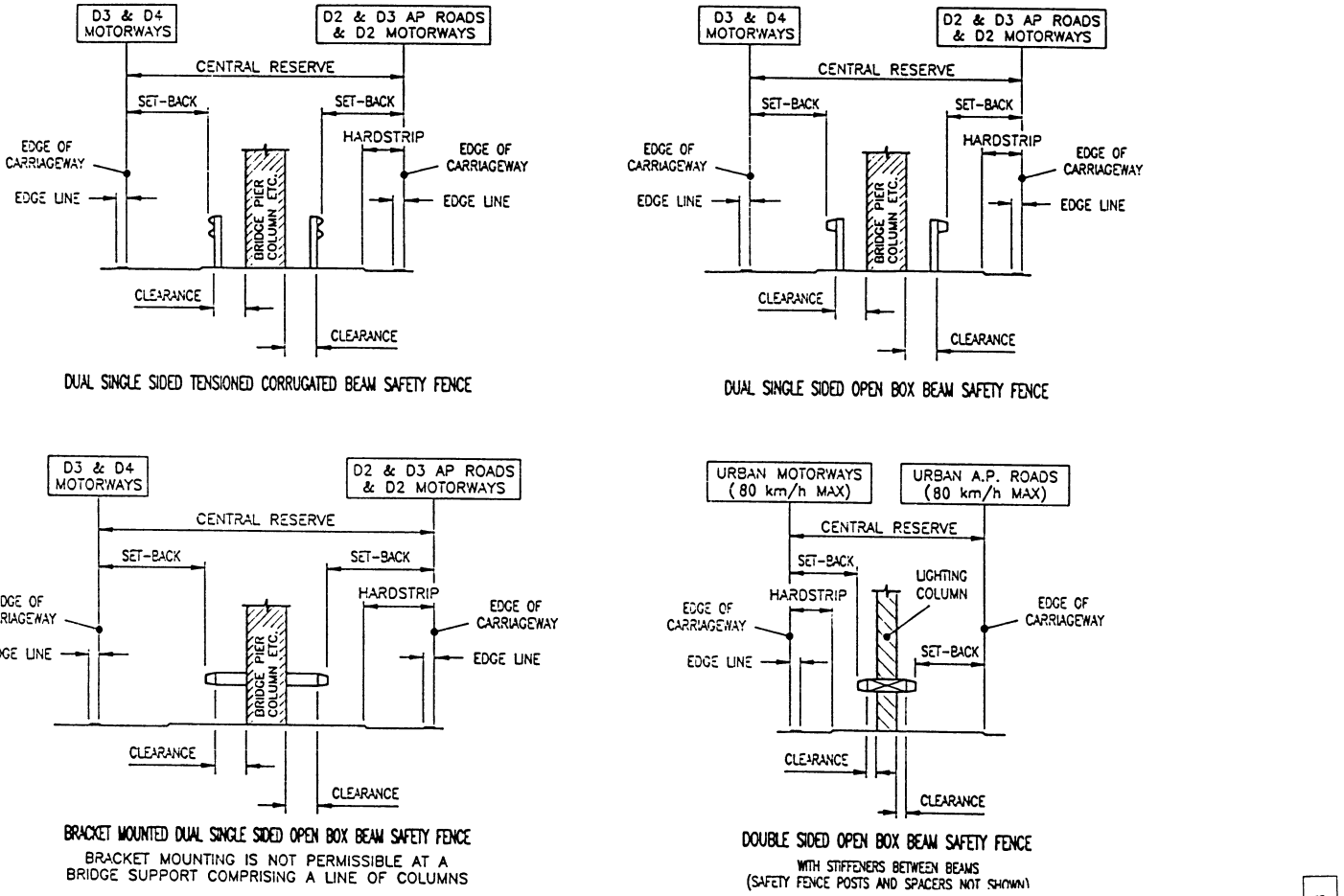


Figure 26 — Set-back and clearance adjacent to structures (central reserve)

b) Where the available clearance is between 600 mm and 800 mm, larger section posts (110 mm × 50 mm) should be used at standard spacing.

3.5.2.5 ***Wire rope safety fence***

a) The post spacing is normally 2.4 m except for the following cases:

i) at the interface with open box beam there should be 14 posts at 1.2 m centres (see GA/50 to GA/54);

ii) when running behind the open box beam and not acting as the primary restraint, the post should be at 4.8 m centres;

iii) when height-restraining posts are used, they should be at 2.5 m centres;

iv) when the minimum clearance is 1.3 m the posts should be at 1.2 m centres;

v) when the minimum clearance is 1.1 m the posts should be at 1.0 m centres.

b) If, at an interface between open box beam and wire rope safety fence, the open box beam extends behind the wire rope safety fence for more than 6.8 m from the interchange point, then the posts for the wire rope safety fence should be at 1.2 m centres for not less than 10 m beyond the open box beam end anchorage. This will not apply if the open box beam is more than 1.7 m behind the wire rope safety fence.

3.5.3 Post foundations

3.5.3.1 Where driven posts or concrete foundation posts appear to be loose or insecure, it may be necessary for a post test to be carried out to ensure that the soil is providing sufficient "moment of resistance" as detailed in the specification.

3.5.3.2 Where post extension pieces are being considered for use on either driven posts or posts with concrete foundations, the engineer is required to carry out post foundation tests as described in the *Specification for Highway Works* (Series 400)[11] and in Annex B of this document, to determine the adequacy of the foundations.

3.5.3.3 For existing concrete foundations that are to be re-used, a number, as determined by the engineer, should be exposed to check for compliance with the specification.

Section 4. Repair of safety fences

4.1 General

This section is designed as a follow on to in-service inspection or for use following damage. Procedures for new safety fences in section **2** should be followed unless otherwise stated.

4.2 Scope of repair work

4.2.1 Beams

4.2.1.1 *General*

COMMENTARY. *Any structural damage to the beam will render it unserviceable. Particular attention should be paid to all bolt holes.*

4.2.1.2 *Mounting height*

COMMENTARY.

a) If damaged section is not more than 10 *standard beam lengths, replace to match existing fence height.*

b) If damaged section is in excess of 10 *standard beam lengths then the beam should be replaced in accordance with* **3.5.1**. *The run-out between the two mounting heights should be made over two or three beam lengths at each end of the damaged section.*

4.2.1.3 *Replacement of tensioned corrugated beams*

COMMENTARY. *All beams that are installed as part of the repair work should be podgered-out from the adjacent beam. (See also* **4.2.2.12**).

Where this results in the replacement length exceeding the length of the gap to be closed, then either:

a) slacken post bolts up to adjacent adjuster assembly and draw the beams back (replacing post bolts); or

b) use an additional adjuster assembly within the replaced section.

4.2.1.4 *Replacement of open box beams*

COMMENTARY. *If the damaged section is in excess of* 100 m *but does not include an expansion assembly, then the opportunity should be taken to include one within the section of the repaired fence.*

If the replacement beams are too long for the length of section to be replaced then either:

a) assemble several beams away from the posts suitably supported and attached at each end to an existing length of fence. Push the assembled beams up to the posts, taking care not to damage the galvanizing; or

b) use an expansion assembly with the expansion gap reset as required. This should accommodate a discrepancy of up to 36 mm. *A half standard beam may also be required.*

4.2.1.5 *Corroded adjuster bolts/anchorage bolts*

COMMENTARY. *Replace any corroded adjuster bolt or anchorage bolt.*

4.2.1.6 *Connection between tensioned corrugated beam and open box beam*

COMMENTARY. *When it is necessary to replace a connection piece made to a pre-1991 specification with one made to the post-1991 specification, an additional tensioner assembly may be required due to the difference in length of these items.*

4.2.1.7 *Welded angled beams (open box beam and untensioned corrugated beam)*

COMMENTARY. *In the event of damage to a welded angled beam, replace immediately in accordance with the appropriate drawing, either GA/18 or GA/20. This may require a new anchor block in order to retain the specified minimum length of full height safety fence.*

4.2.1.8 *Incomplete work*

COMMENTARY. *When no work is being undertaken on an incompleted section of fence, it should be protected by an assembled beam, with hand tightened fasteners, ramped down and dug into ground or protected with sandbags.*

4.2.1.9 *Wire ropes*

COMMENTARY. *If, in the event of an accident, any wire of the rope is damaged, the regional office of the Department of Transport and the original wire rope manufacturer should be informed. The breaking of one wire does not necessarily mean that the fence is unserviceable and expert advice should be sought.*

4.2.2 Posts

4.2.2.1 *General*

COMMENTARY. *Any structural damage to a post will render it unserviceable. It is necessary to identify the type of post used, i.e. either driven standard, driven long, or intermediate.*

Where a post has moved out of the correct upright position in the ground but has not yielded near ground level, this will indicate that the stability of the ground is suspect. Post foundation tests should be considered. See Annex B.

A post that is loose in the ground should be removed and replaced. Attempting to consolidate the soil around an in-situ post is not satisfactory.

4.2.2.2 *Driven posts*

COMMENTARY. *Where a standard driven post has moved out of the correct upright position in the ground, it should be normally replaced with a long driven post unless there is evidence to suggest that a designed concrete footing is required, the size of which should be determined by the Engineer. A check on the location of buried services should be carried out prior to the driving of any post.*

Where a long driven post is no longer in the correct upright position, it will be necessary to provide a concrete foundation, the size of which should be determined by the Engineer. (See **4.2.2.5** *and* **4.2.2.6**).

4.2.2.3 *Driven post spacing for tensioned corrugated beams*

COMMENTARY. *If the damaged posts are at standard centres, then drive the new posts to correspond with the post bolt slot midway between the original post locations. This will result in the posts at either end of the repaired section being* 1.6 m *from the adjacent undisturbed post.*

4.2.2.4 *Driven posts spacing for open box beams/rectangular hollow sections*

COMMENTARY. *Within the damaged section, drive the new posts in undisturbed ground at standard spacing. This will result in the posts at either end of the repaired section being closer than the standard spacing to the undisturbed post.*

4.2.2.5 *Posts in concrete foundations*

COMMENTARY. *Any concrete foundation that has been disturbed should be removed and replaced with a new designed foundation, the size of which should be determined by the Engineer.*

A damaged post in any special undisturbed designed concrete foundation may be cut off at surface level and the concrete cored to provide a socket foundation. Alternatively a surface-mounted post may be used.

4.2.2.6 *Concrete foundations and sockets (intermediate posts)*

COMMENTARY.

i) Ensure design is in accordance with GA series of drawings (see Annex C).

ii) The engineer should advise on type of post and whether it is to be set directly into the concrete foundation or if a socket can be used. Install post to socket and fill void with a non-setting passive filler to a level slightly above the top of the socket (or fit excluder if specified).

4.2.2.7 *Intermediate posts set in plastic bags*

COMMENTARY. *Where foundations with plastic bags are found, the plastic should be cut off at ground level and the detritus removed. If the post is found to be unserviceable, it should be replaced. Where the galvanizing only has been affected, it should be cleaned thoroughly and such areas should be treated with two coats of approved zinc-rich paint. Any pockets left around the post should be made good with an approved sand/cement mix sloping away from the post or expanding plastic foam.*

4.2.2.8 *Surface-mounted posts set on plinths*

COMMENTARY. *Plinths under posts should not exceed* 75 mm *without prior approval of the Engineer.*

4.2.2.9 *Surface-mounted posts*

COMMENTARY. *Prior to the replacement of a surface-mounted post, the holding down bolts should be examined to ensure that none of them have been pulled out of the concrete. Any movement or structural damage will render the bolts unsuitable for further use and they should be replaced with suitable fastenings which are able to withstand the pull-out load as specified in the Specification for Highway Works (series 400)[11].*

4.2.2.10 *Damage to post only or post missing*

COMMENTARY. *Where the post is unserviceable but the beam is undamaged, there may be no need to dismantle the beam prior to replacing the post.*

4.2.2.11 *"Z" post orientation*

COMMENTARY. *Any posts found to have the incorrect orientation need not be changed unless other defects in the fence are noted. The Engineer should be informed of posts incorrectly orientated.*

4.2.2.12 *Slot bound posts with tensioned corrugated beams*

COMMENTARY. *Where the only fault in beams and posts is that the post bolts are located at the end of the slot in the beams, no further action is required other than to inform the Engineer. If the posts have been pulled out of vertical, then the post bolts should be slackened and the beams pulled back at the next adjuster. When retensioning the fence, replace these post bolts.*

4.2.2.13 *Wooden posts with untensioned corrugated beams*

COMMENTARY. *Metal posts and brackets should be used as replacements of fence originally erected on wooden posts.*

4.2.2.14 ***Deflection posts with wire rope safety fences***

COMMENTARY. *If an accident occurs within* 100 m *of an end anchor, then the deflection posts should be inspected. The Engineer should be advised if there is any sign of movement.*

4.2.2.15 ***Replacement of 100 × 30 with 110 × 50 "Z" Posts***

COMMENTARY.

i) The resulting bulge in alignments is acceptable.

ii It may be necessary to use longer connector straps.

4.2.3 Anchors

4.2.3.1 ***Anchorages***

COMMENTARY. *If an accident occurs within* 50 m *of a ramped end or full height anchor, then the anchor block should be inspected. The Engineer's instructions should be sought if there is any sign of movement.*

4.2.3.2 ***Full height anchorages***

COMMENTARY. *Where full height anchorages are set directly into concrete and the frame is damaged but the concrete foundation is sound and undisturbed, then either:*

a) cut off the frame at the surface of the concrete and core to provide sockets for new frame; or

b) cut off the frame at the surface of the concrete; fill the holes with concrete and install a surface-mounted frame.

4.2.4 Fasteners

4.2.4.1 Any fastener in the damaged section should be replaced with new components conforming to current specifications.

4.2.4.2 Any post screws affected by re-tensioning should be replaced with a new component conforming with the current specification.

4.3 Procedure for repairs

4.3.1 Tensioned fences beam and post replacement with tensioned corrugated beams and rectangular hollow sections

a) Identify damaged beams and posts

b) Slacken post screws/bolts (and straps) in the section to be detensioned.

c) Detension at the adjuster/tension assembly on either side of the damaged section.

d) Remove damaged beams.

e) Remove damaged posts (and concrete foundations).

f) As determined by the Engineer, either:

i) compact the ground where posts are to be driven at the same location; or

ii) excavate with vertical sides for a concrete foundation to an intermediate steel post.

g) Provide new posts correctly orientated to line and level.

COMMENTARY. *Operations a) to g) should be undertaken in accordance with* **4.2.2.1** *to* **4.2.2.12**.

h) Assemble beams.

i) Tension.

j) Clear site.

COMMENTARY. *Operations h) to j) should be undertaken in accordance with* ***2.1*** *and* ***2.4****, and also* ***1.5***.

4.3.2 Untensioned fences beam and post replacement with open box beams and untensioned corrugated beams

a) Identify damaged beams and posts.

b) Remove damaged beams.

c) Remove damaged posts/offset brackets (and concrete foundations).

d) As determined by the engineer, either:

i) consolidate acceptable fill material in the hole from which the post has been withdrawn; or

ii) excavate with vertical sides suitable for a concrete foundation to an intermediate steel post.

e) Provide new posts correctly orientated to line and level.

COMMENTARY. *i) Operations a) to e) should be undertaken in accordance with* **4.2.2.1** *to* **4.2.2.13**.

ii) Steel "Z" posts should be used in the maintenance of untensioned corrugated beams originally erected on wooden posts.

f) Assemble beams.

g) Clear site.

COMMENTARY. *Operations e) to g) should be undertaken in accordance with* ***2.2*** *and* ***2.3****, and also* ***1.5***.

4.3.3 Tensioned fences post replacement with wire rope safety fences

a) Identify damage to post(s).

b) As determined by the Engineer:

i) remove damaged post(s);

ii) replace damaged post(s).

c) Check tensioning at rigging screws within damaged section and adjacent undisturbed sections and retension as necessary.

d) Clear site.

COMMENTARY. *Operations a) to d) should be undertaken in accordance with* ***4.2.2.1*** *to* ***4.2.2.12***.

4.3.4 Tensioned fences rope replacement

The replacement of a damaged rope is to be undertaken in accordance with the installation procedures in **2.5**.

COMMENTARY. *It is essential that the Engineer is informed of any breakages. The breaking of one wire does not necessarily mean that the fence is unserviceable.*

The weave pattern of the ropes should be maintained and extra posts cannot be inserted where this will affect the pattern.

Nominal spacing for the posts is 2.4 m *but this may be adjusted to allow for redriving. The distance between two adjacent posts should be not more than 2.65 m.*

See also ***4.2.2***.

Section 5. Transportation and storage of materials

5.1 Delivery

Upon delivery, samples of the materials should be checked for conformance to the specification.

COMMENTARY. *Arrangements should be made to check manufacturer's quality assurance certificate for conformance to BS 5750 and/or other appropriate quality assurance schedules.*

5.2 Handling

5.2.1 All materials should be handled, transported and stored in such a way that damage to components and protective coatings is avoided.

5.2.2 When transporting materials, care should be taken to stiffen free ends and prevent permanent distortion.

5.2.3 Where it is not possible to identify a small item individually, then it may be wired, banded or bagged with other similar items and marked with an appropriate label.

5.2.4 All materials including bolts, nuts, washers and small plates should be suitably packed and identified.

5.2.5 Fabric straps should be used for securing loads.

COMMENTARY. *Chains may be used provided that the metal coating is protected.*

5.2.6 When ordering, the supplier should be advised of the lifting capacities at the site or depot so that the appropriate arrangements can be made.

5.2.7 Preferably fabric slings should be used for handling unless components incorporate lifting eyes.

COMMENTARY. *Fabric slings should be protected at the sharp edges of the components.*

Where lifting forks are used they should be suitably protected to avoid metal-to-metal contact.

5.3 Storage/packing

5.3.1 Storage areas are best laid out so that the heaviest and most frequently used components are easily accessible.

5.3.2 Beams and barriers should be stored in a safe manner, clear of the ground and in such a way that contact with groundwater, soil, ash or other deleterious materials is prevented and rainwater does not accumulate on the surfaces or inside hollow sections.

5.3.3 Different grades and sizes of fasteners should be stored in separately labelled containers and an approved recording method for the control of components from manufacture to their erection on site should be adopted.

5.3.4 Materials delivered to site should be stored in such a manner that they do not constitute a hazard or restrict visibility for road users.

5.3.5 When taken from store, materials should be checked for deterioration.

COMMENTARY. *Components should not be stored within the clearance areas of existing fences.*

Section 6. Training

6.1 Training courses

6.1.1 A requirement of the Quality Assurance Scheme for Safety Fences is that all erectors should have successfully completed an approved training course for the type of fence on which they are required to work.

NOTE See BSI QGN 5000/5.

6.1.2 The National Fencing Training Authority (NFTA) accredits and validates the approved courses which are offered at various training centres throughout the country. The addresses of the training centres may be obtained from the NFTA.

6.1.3 Training is provided on a modular basis as detailed in Table 5. The "add-on" modules can only be used by those erectors who have successfully completed the basic module.

The stand-alone module can be used by erectors who do not wish to be trained on other types of fences.

6.1.4 Upon the successful completion of a module, an erector will be issued, by the NFTA, with an identity card valid for a period of 5 years. This card will indicate the type(s) of fence covered by the course.

Re-issue of this card will be subject to an erector successfully completing a refresher course within a period of 6 months prior to the expiry date.

6.1.5 Training of supervisors and engineers. Some of the training centres that provide the erector training also provide training courses for supervisors, clerks of works, inspectors, technicians and engineers. It is recommended that the above personnel should attend one of these courses.

6.2 National register

A national register is maintained to record the details of all erectors who have successfully completed approved courses by the

National Fencing Training Authority (NFTA)

Suite 18

IMEX Business Park

Shobnall Road

Burton-on-Trent

DE14 2AU

Tel. 0283 512611.

Fax. 0283 515049

Table 5 — Training modules for safety fence erectors

Type of module	Fence types covered	Duration
Basic	Tensioned corrugated beam Untensioned corrugated beam Open box beam Double rail open box beam	5 days
Wire rope (add-on)	Wire rope	2 days
Wire rope (stand-alone)	Wire rope	3 days
Rectangular hollow section (add-on)	Rectangular hollow section	1 day
Rectangular hollow section (stand-alone)	Rectangular hollow section	2 days

Annex A (informative) Quality assurance

A.1 General

A.1.1 *The Specification for Highway Works*[11], published in 1986 (6th edition) incorporated the requirement for safety fence work to be undertaken by firms holding third party accreditation for Quality Assurance. The details of the scheme were based upon work originally undertaken by the Fencing Contractors Association in conjunction with British Standards Institution Quality Assurance.

A.1.2 The specification also included a requirement that materials were to be supplied by firms holding third party accreditation for quality assurance.

A.1.3 In the *Specification for Highway Works,* which was published as part of the *Manual of Contract Documents*[11] in 1991, the terminology was changed. The requirement is that manufacturers, suppliers and erectors operate quality management schemes.

A.2 Quality management schemes

A.2.1 Quality Management Schemes are operated in accordance with BS 5750. Those firms which propose to undertake work related to safety fences are required to have their management systems audited by an independent organization which has been approved by the National Accreditation Council for Certification Bodies. Currently the Department of Transport has accepted that the following organizations will be the certification bodies responsible for "third party" accreditation:

a) British Standards Institution Quality Assurance (BSI QA) for firms that supply and erect or manufacture fasteners;

b) British Standards Institution Quality Assurance and Lloyd's Register Quality Assurance Ltd., for firms that manufacture components.

A.3 Quality Guidance Note/Quality System Supplement

A.3.1 *Supplementary advice*

BS 5750 is written in terms so that it can apply to any commercial activity. It is therefore considered desirable, in certain situations, to offer supplementary advice. This is set out in a Quality Guidance Note (QGN) (formerly known as a Quality Assessment Schedule) issued by BSI QA or a Quality System Supplement (QSS) issued by Lloyds Register QA. These documents are prepared by committees formed from representatives of clients and contractors.

A.3.2 *Requirements for the client and contractor*

A.3.2.1 *General*

The QGN or QSS sets out various requirements for the client and contractor, so that there is uniformity in this sector of work, and includes references to the *Specification for Highway Works*[11] and other relevant standards, and other client specifications and/or standards.

A.3.2.2 *Definitions of personnel*

a) *Vehicle safety fence erector*

A vehicle safety fence erector is a person who:

i) has successfully completed the appropriate training referred to in section **6** of this standard and has knowledge of traffic management systems:, including the requirements of Chapter 8 of the *Traffic Signs Manual* [2]; and

ii) has a minimum of 12 months' recorded experience in vehicle safety fence erecting or an NVQ/SVQ in fence erection (level 2) based upon vehicle safety fence work.

b) *Fence operative*

A fence operative is a person who works under the control and guidance of a vehicle safety fence erector.

c) *Nominated representative*

A nominated representative is a person nominated by the firm erecting the safety fence who holds site management responsibility for the safety fence work.

A.3.2.3 *Staff*

a) The firm should maintain service records of fence erectors and operatives.

b) A vehicle safety fence erector [see **A.3.2.2** a)] should be present on site during any vehicle safety fence erection which may exclude the excavation of foundations.

c) A vehicle safety fence erector may be assisted by a maximum of five fence operatives [see **A.3.2.2** b)].

A.3.2.4 *Procedures for complaints*

The firm erecting the safety fence should keep records of all written complaints. The complaints should be separated into suitable categories which should include:

a) defective material;

b) standard of work;

c) interpretation of the contract.

FORM 1. NOTIFICATION OF COMPLAINT REGARDING OPERATION OF A QUALITY ASSURANCE SCHEME

1. Name of complainant and organization: .....
2. The quality assurance scheme (and schedule no. if known): .....
3. Name of firm undertaking the works: .....
4. Location of work: .....
5. Date work carried out: .....
6. Was the work a sub-contract? If yes give name of main contractor: .....
7. Was a certificate of conformity provided by the firm (if applicable)? .....
8. Which specification was used? (e.g. give BS, *Specification for Highway Works*[11] or client's specification (provide details):

   .....

   .....
9. With which clauses of the BS or other specification do the products/works appear not to comply (state clause nos.): .....

   .....
10. Details of the complaint and which aspects of the works appear unsatisfactory (use separate sheet if appropriate): .....

    .....

    .....

    .....
11. At what point was the problem identified and was a warning given?: .....

    .....
12. Has the firm been formally advised of the problem? YES/NO - Verbal/written .....
13. If yes to Q12 what was the response?: .....

    .....

    .....
14. Give reasons for your concern: .....

    .....

    .....

DATE: SIGNATURE.....

for and on behalf of.....

Copies issued to:

(a) Registration Authority
(b) Registered firm
(c) Main contractor (where applicable)
(d) Client (if different from Q1)
(e) Others

Figure A.1 — Example of a form for notification of complaints

FORM 2. CONFIRMATION OF VERBAL SITE INSTRUCTION* OR WRITTEN NOTIFICATION OF NON-CONFORMING REQUIREMENTS*

From .....

To .....

Contract .....

Verbal instruction / Non-conforming requirement .....

.....

.....

.....

.....

Issued by .....

Date issued .....

We hereby confirm receipt of the verbal instruction/notify you of the non-conforming requirement* referred to above.

We have to respectfully point out that in our opinion, and without prejudice to the responsibility solely conferred upon you for the Design of the Works, this instruction/requirement* contravenes the requirements of/good practice inherent in *the Manual of Contract Documents for Highway Works which incorporates Quality Management Sector Schemes to BS 5750.

Purely for information purposes, we describe the contravention as:-

.....

.....

.....

.....

.....

.....

.....

(continued on separate sheet as necessary)

DATE: SIGNATURE .....

for and on behalf of .....

* Delete as appropriate

Copies issued to:

(a) Main contractor

(b) Subcontractor

(c) Resident/engineer

(d) Others

Figure A.2 — Example of a form for written confirmation of verbal instructions

Figure A.1 shows a suitable form for the notification of complaints and provides the opportunity for the safety fence erecting firms to reply and rectify the non-compliance.

Figure A.2 shows a suitable form for confirming in writing any verbal instruction issued by a third party and also drawing attention to any contravention this would cause with the contract documents, other standards or good working practice.

Annex B (informative) Post foundation test

B.1 General

This annex describes the test procedures for ascertaining the strength of the ground in which it is proposed to install the safety fence.

B.2 For 100 × 32 and 110 × 50 "Z" section steel posts

B.2.1 *Loading*

B.2.1.1 Apply test load to the post in the direction in which it would be loaded in service or, in the case of double sided safety fence, in the direction of weakest foundation.

B.2.1.2 Decide whether to use push or pull mode for the test.

NOTE For 100 × 32 "Z" Section use pull mode if possible.

B.2.2 ***Pull mode*** (see Figure B.1)

B.2.2.1 Clamp appropriate post box (C1 or C2) onto the post.

B.2.2.2 Screw yoke (A) onto the cylinder (B).

B.2.2.3 Connect the hydraulic pipes to the cylinder (B) and pump (Q).

B.2.2.4 Attach yoke (A) to the post box (C1 or C2) with screw pins (E1).

B.2.2.5 Screw the slip lock (F) to the cylinder (B).

B.2.2.6 Screw the eye bolt (G) to the slip lock (F).

B.2.2.7 Attach the chain to the eye bolt (G) with the shackle (R).

NOTE Use 1.5 tonne safe working load (SWL) chain for 100 × 32 and 110 × 50 sections.

B.2.2.8 Fully extend the cylinder (B) with switch valve on the pump (Q) on "push" mode. Do not overload push load indicator (S1) when extending the cylinder (B). Position the switch valve to neutral position at the end of this operation.

B.2.2.9 Ensure that the anchorage point on the reaction vehicle (minimum weight 5 tonne) is perpendicular to the load direction, and attach the chain to it. Remove initial slack on the chain using the adjustment claw and the remaining slack with the slip lock (F).

B.2.2.10 Switch the valve on the pump (Q) to "pull" mode.

B.2.2.11 Place the datum tripod (T) in line with the direction of loading, ensuring it is isolated from foundation movement.

B.2.2.12 Measure within ± 15 mm the height of loading (L) (see **B.2.4.3**).

B.2.2.13 Measure and mark within ± 15 mm the position on the post where deflection measurement is to be taken (see **B.4.2**).

B.2.2.14 Record the distance between the post and the datum tripod (T).

B.2.2.15 Apply incremental load (in steps of 1 000 N approximately). Record the load and the deflection of the post within ± 1 mm at each increment until one of the conditions below is reached:

a) a bending moment of 6 000 N · m is achieved;

b) the post deflects 100 mm at measuring position (see **B.2.4.2** to **B.2.4.4**).

NOTE The pump (Q) should be operated with a smooth and continuous action.

B.2.3 ***Push mode*** (see Figure B.2)

B.2.3.1 Proceed as described in **B.2.2.1** to **B.2.2.5**.

B.2.3.2 Connect extension tube (H), extension rod (J), adaptors (K and L) and flat base (M) together and screw into the slip lock (F).

B.2.3.3 Fully retract the cylinder (B) with switch valve on the pump (Q) on "Pull" mode. Do not overload pull load indicator (S2) when retracting the cylinder. Position the switch valve to neutral position at end of this operation.

B.2.3.4 Locate the reaction vehicle in a suitable position ensuring the contact point formed between the flat base (M) and the vehicle [via adjusting extension tube (H), extension rod (J) and slip lock (F)] is perpendicular to the load direction.

NOTE It is possible to push against the rear wheels with timber baulk between the wheel and flat base (M).

B.2.3.5 Ensure that the load is applied horizontally.

B.2.3.6 Switch the valve on the pump (Q) to "Push" mode.

B.2.3.7 Follow steps **B.2.2.11** to **B.2.2.15**.

B.2.4 *Calculations*

B.2.4.1 Results should be recorded on the form shown in Figure B.5.

B.2.4.2 The deflection of the post should be measured 600 mm above either:

a) the edge of the paved surface, if the traffic face of the fence is within 1.5 m of the edge; or

b) the finished ground level at the base of the post or top of the concrete footing, whichever is higher, when the traffic face of the fence is more than 1.5 m from the edge of the paved surface.

NOTE Paved surface is defined as that which comprises carriageway and hardshoulder/hardstrip.

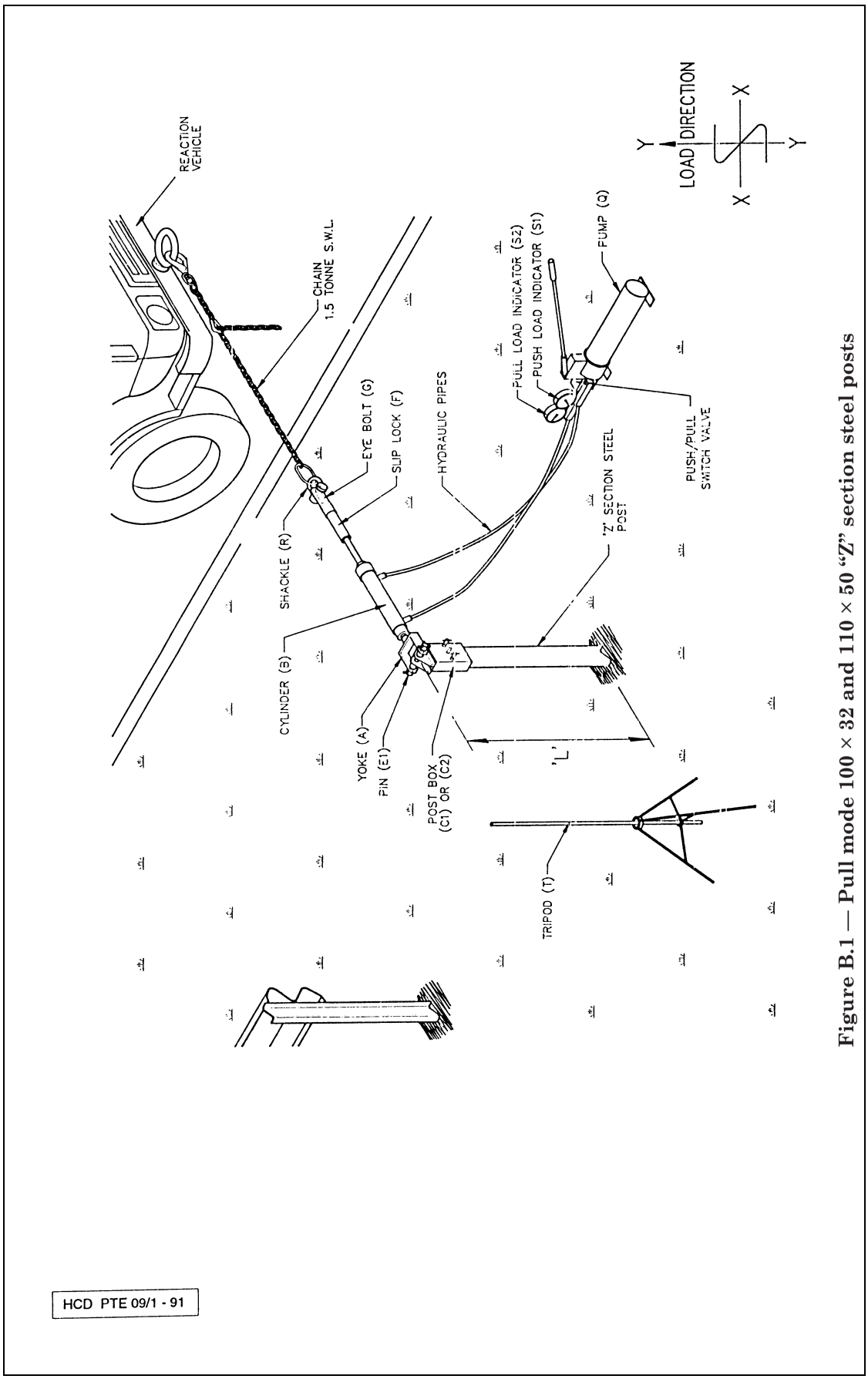


Figure B.1 — Pull mode 100 × 32 and 110 × 50 "Z" section steel posts

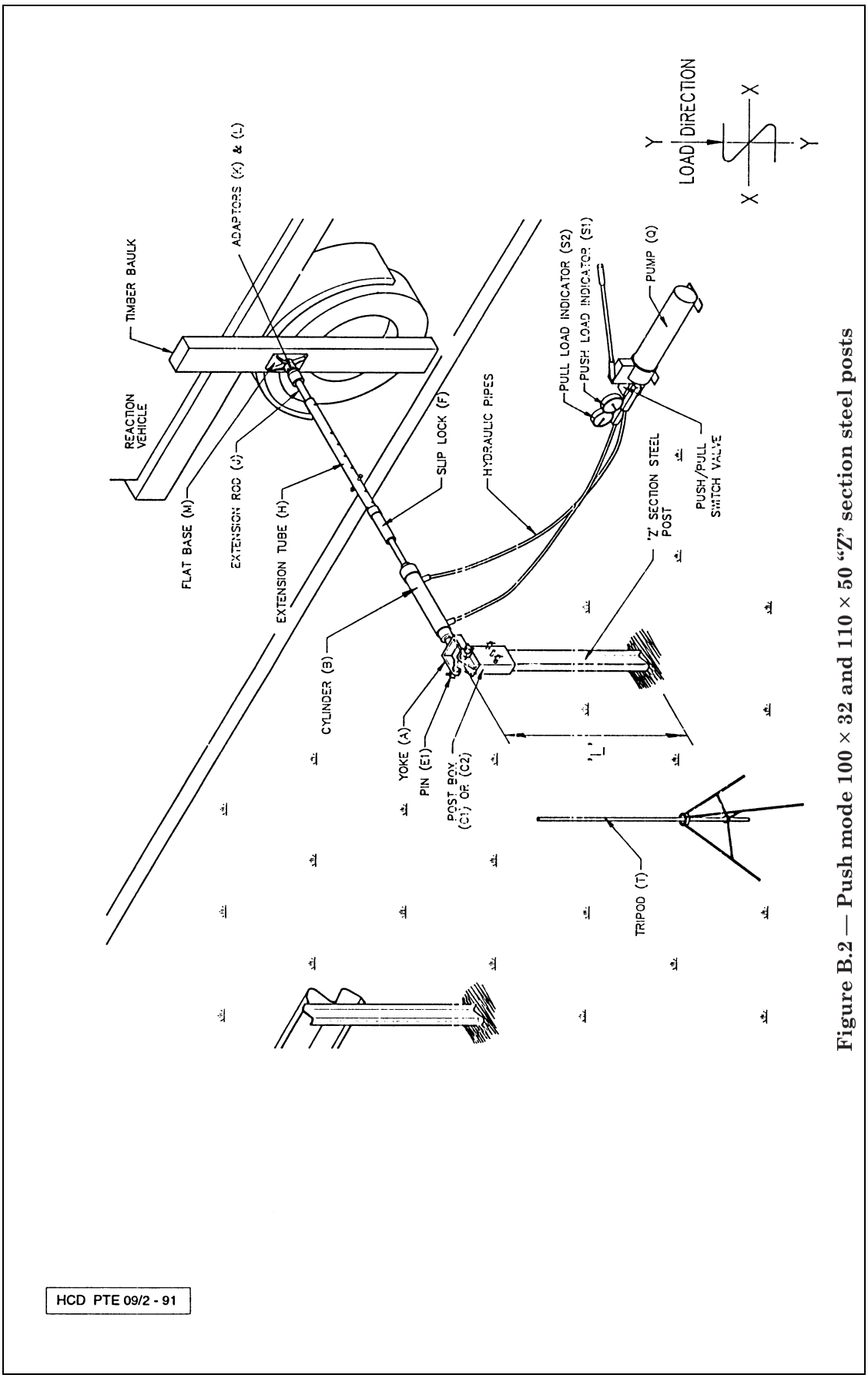


Figure B.2 — Push mode 100 × 32 and 110 × 50 "Z" section steel posts

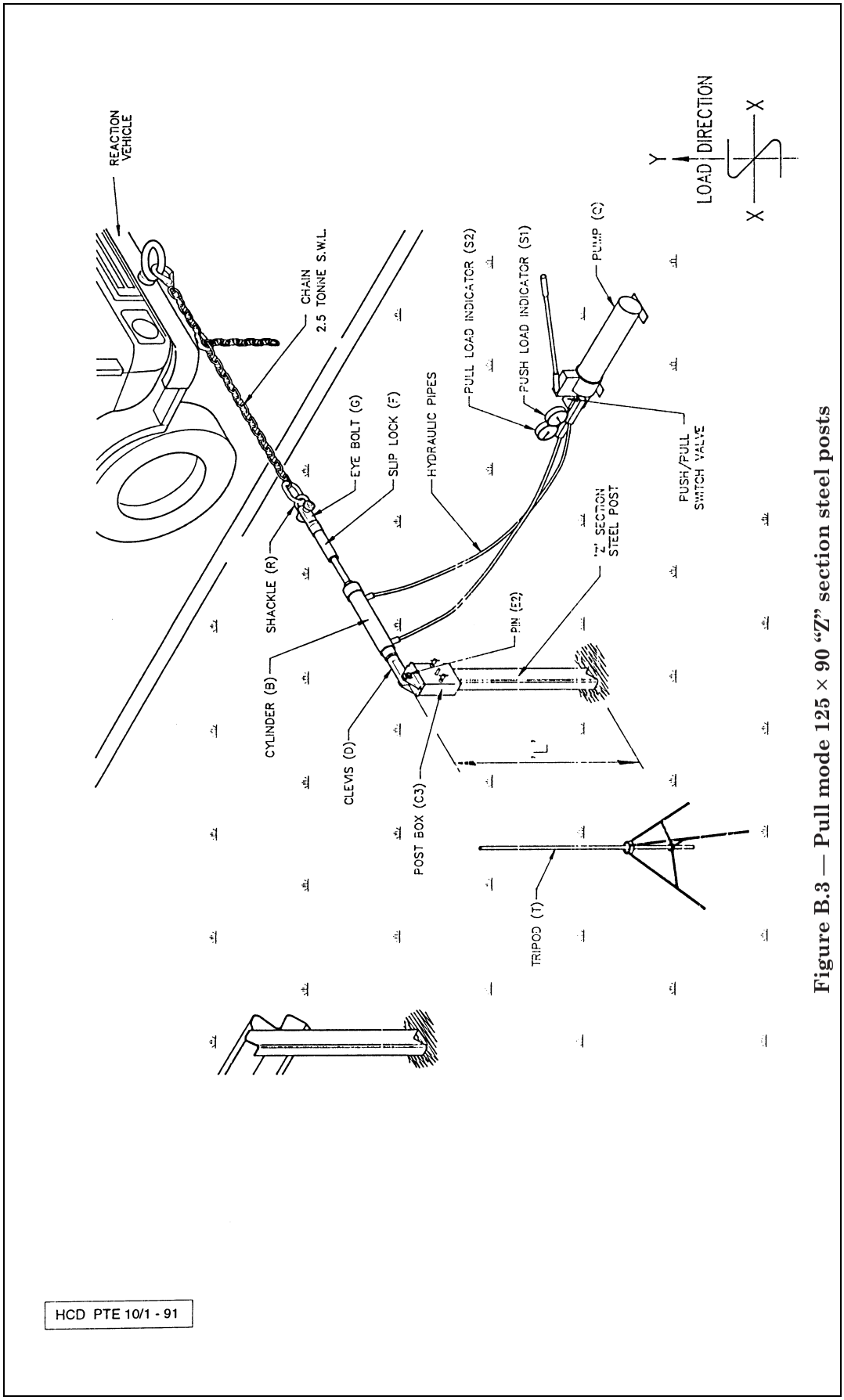


Figure B.3 — Pull mode 125 × 90 "Z" section steel posts

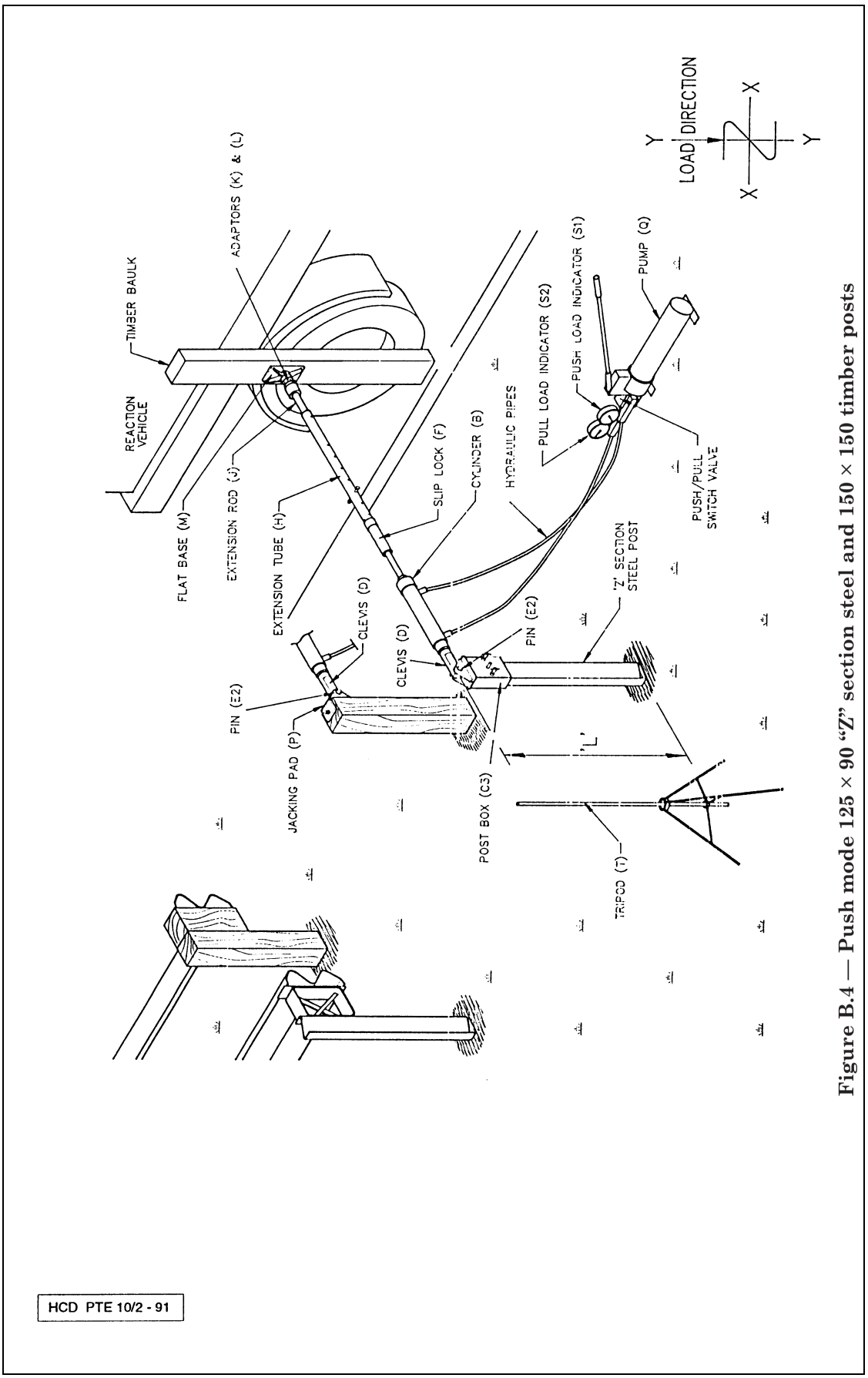


Figure B.4 — Push mode 125 × 90 "Z" section steel and 150 × 150 timber posts

B.2.4.3 Bending moment, *BM,* on the post/foundation is calculated from the following equation.

$BM = W \times L$

where:

W is the load indicated on the load indicator (in N);

L is the height between the point of loading (in m);

and either

a) the edge of the paved surface, if the traffic face of the fence is within 1.5 m of the edge; or

b) the finished ground level or top of the concrete footing, whichever is smaller, when the traffic face of the fence is more than 1.5 m from the edge of the paved surface.

B.2.4.4 The post foundation is acceptable if a bending moment of 6 000 N · m is achieved without the deflection exceeding 100 mm.

B.3 For 125 × 90 "Z" section steel posts

B.3.1 ***Loading***

B.3.1.1 Apply test load to the post in the direction in which it would be loaded in service or, in the case of double sided safety fence, in the direction of weakest foundation.

B.3.1.2 Decide either push or pull mode for the test.

B.3.2 ***Pull mode*** (see Figure B.3)**.**

B.3.2.1 Clamp appropriate post box (C3) onto the post.

B.3.2.2 Screw clevis (D) onto the cylinder (B).

B.3.2.3 Connect the hydraulic pipes to the cylinder (B).

B.3.2.4 Attach clevis (D) to the post box with pin (E2).

B.3.2.5 Screw the slip lock (F) to the cylinder (B).

B.3.2.6 Screw the eye bolt (G) to the slip lock (F).

B.3.2.7 Attach the chain to the eye bolt (G) with the shackle (R).

NOTE Use 2.5 tonne SWL chain for 125 × 90 section.

B.3.2.8 Fully extend the cylinder (B) with switch valve on the pump (Q) on "push" mode. Do not overload push load indicator (S1) when extending the cylinder. Position the switch valve to neutral position at end of this operation.

B.3.2.9 Ensure that the anchorage point on the reaction vehicle (minimum weight 5 tonne) is perpendicular to the load direction, and attach the chain to it. Remove initial slack on the chain using the adjustment claw and the remaining slack with the slip lock (F).

B.3.2.10 Switch the valve on the pump (Q) to "pull" mode.

B.3.2.11 Place the datum tripod (T) in line with the direction of loading, ensuring it is isolated from foundation movement.

B.3.2.12 Measure within ± 15 mm the height of loading (L) (see **B.3.4.3**).

B.3.2.13 Measure and mark within ± 15 mm the position on the post where deflection measurement is to be taken (see **B.3.4.2**).

B.3.2.14 Record the distance between the post and the datum tripod (T).

B.3.2.15 Apply incremental load (in steps of 1 000 N approximately). Record the load and the deflection of the post within ± 1 mm at each increment until one of the conditions below is reached:

a) a bending moment of 9 000 N · m is achieved;

b) the post deflects 150 mm at measuring position (see **B.3.4.2** to **B.3.4.4**).

NOTE The pump (Q) should be operated with a smooth and continuous action.

B.3.3 ***Push mode*** (see Figure B.4)

B.3.3.1 Proceed as described in **B.3.2.1** to **B.3.2.5**.

B.3.3.2 Connect extension tube (H), extension rod (J), adaptors (K and L) and flat base (M) together and screw into the slip lock (F).

B.3.3.3 Fully retract the cylinder (B) with switch valve on the pump (Q) on "pull" mode. Do not overload pull load indicator (S2) when retracting the cylinder. Position the switch valve to neutral position at the end of this operation.

B.3.3.4 Locate the reaction vehicle in a suitable position ensuring the contact point formed between the flat base (M) and the vehicle [via adjusting extension tube (H), extension rod (J) and slip lock (F)] is perpendicular to the load direction.

NOTE It is possible to push against the rear wheels with timber baulk between the wheel and flat base (M).

B.3.3.5 Ensure that the load is applied horizontally.

B.3.3.6 Switch the valve on the pump (Q) to "push" mode.

B.3.3.7 Follow steps **B.3.2.11** to **B.3.2.15**.

B.3.4 ***Calculations***

B.3.4.1 Results should be recorded on the form shown in Figure B.5.

B.3.4.2 The deflection of the post should be measured 600 mm above either:

a) the edge of the paved surface, if the traffic face of the fence is within 1.5 m of the edge; or

b) the finished ground level at the base of the post or top of the concrete footing, whichever is higher, when the traffic face of the fence is more than 1.5 m from the edge of the paved surface.

Job No. .....
Sheet ..... of ....

Agent Authority / ..... Site ..... Date .....
Consulting Engineer

Test no.	Details of post/foundations and location (central reserve or other)	Test mode i.e. push (Ps)/ pull (Pl)	Loading height m	Incremental loading value N	Deflection mm	Bending moment N·m	Remarks (e.g. pass/fail)

Specification details .....

Tested by (name) ..... Signed ..... Date / /

Duplicate copy to be forwarded to: Local Highway Authority Archive Records Department in accordance with Quality Assurance Scheme Procedures

Figure B.5 — Safety fence post foundation test results

B.3.4.3 Bending moment, *BM,* on the post/foundation is calculated from the following equation.

$BM = W \times L$

where:

W is the load indicated on the load indicator (in N);

L is the height between the point of loading (in m);

and either

a) the edge of the paved surface, if the traffic face of the fence is within 1.5 m of the edge; or

b) the finished ground level or top of the concrete footing, whichever is smaller, when the traffic face of the fence is more than 1.5 m from the edge of the paved surface.

B.3.4.4 The post foundation is acceptable if a bending moment of 9 000 N · m is achieved without the deflection exceeding 150 mm.

Annex C (normative) List of drawings

This annex lists the drawings referred to in BS 7669-3 that are published in the *Manual of Contract Documents for Highway Works,* (MCHW3), *Highway Construction Details* (Section **2**)[8].

NOTE Drawing references for the Transport Research Laboratory are now obsolescent but may also be useful for maintenance purposes.

Drawing no.	Title
GA/07	Central reserve, layout at fence crossover
GA/11	Tensioned corrugated beam single and double sided, general arrangement (sheet 1 of 3)
GA/12	Tensioned corrugated beam single and double sided, general arrangement (sheet 2 of 3)
GA/13	Tensioned corrugated beam single and double sided, general arrangement (sheet 3 of 3)
GA/18	Untensioned corrugated beam, single sided, general arrangement (sheet 1 of 2)
GA/19	Untensioned corrugated beam, single sided, general arrangement (sheet 2 of 2)
GA/20	Open box beam in verge and central reserve, general arrangement (sheet 1 of 4)
GA/21	Open box beam in verge and central reserve, general arrangement (sheet 2 of 4)
GA/22	Open box beam in verge and central reserve, general arrangement (sheet 3 of 4)
GA/23	Open box beam in verge and central reserve, general arrangement (sheet 4 of 4)
GA/24	Open box beam, double sided, enclosing lighting columns general arrangement (sheet 1 of 2)
GA/25	Open box beam, double sided, enclosing lighting columns general arrangement (sheet 2 of 2)
GA/50	Verge — wire rope safety fence interface with open box beam at structures
GA/51	Verge — alternative wire rope safety fence interface with open box beam at structures on single carriageways
GA/52	Central reserve — Wire rope safety fence interface with open box beam at structures on dual carriageways
GA/53	Open box beam/wire rope safety fence interface general arrangement 1
GA/54	Open box beam/wire rope safety fence interface general arrangement 2
RHS 47/1	Tensioned rectangular hollow section beam safety fence (100 mm × 100 mm)
RHS 48/1	Tensioned rectangular hollow section beam safety fence (200 mm × 100 mm)
WR/06	Anchor blocks — central reserve
WR/09	Anchor blocks — verge

blank

List of references (see 1.2)

Normative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 5750, *Quality systems.*

BS 5750-2, *Specification for production and installation.*

BS 6579, *Safety fences and barriers for highways.*

BS 6579-1:1988, *Specification for components for tensioned corrugated beam safety fence on Z posts.*

BS 6579-3:1988, *Specification for components for tensioned rectangular hollow section beam (100 mm × 100 mm) safety fence.*

BS 6579-4:1990, *Specification for components for tensioned rectangular hollow section beam (200 mm × 100 mm) safety fence.*

BS 6579-5:1986, *Specification for open box beam safety fence (single height).*

BS 6579-6:1988, *Specification for components for open box beam safety fence (double height).*

BS 6579-7:1989, *Specification for components for untensioned corrugated beam safety fence.*

BS 6703:1988, *Specification for manually operated torque wrenches and drivers.*

Other references

[8] *Manual of Contract Documents for Highway Works,* (MCHW), *Highway Construction Details* (HCD). HMSO, 1992.

[9] *Trunk Road Maintenance Manual,* Volume 2, *Routine and Winter Maintenance Code.* Department of Transport, 1992.

[10] *Highway Maintenance: A Code of Good Practice.* Local Authorities Association, 1989.

[11] *Manual of Contract Documents for Highway Works,* (MCHW1), *Specification for Highway Works.* HMSO, 1986 and 1991.

[12] *Design Manual for Roads and Bridges,* Volume 2, (DMRB2), Departmental Standard TD 32/93 "Wire Rope Safety Fence", Department of Transport, 1990.

[13] *Design Manual for Roads and Bridges,* Volume 2, (DMRB2), Departmental Standard TD 19/85 (+ amendment no.1, Nov 1986) "Safety Fences and Barriers", Department of Transport, 1985.

Informative references

BSI QA publications

BRITISH STANDARDS INSTITUTION, Milton Keynes

QGN 5000/5 *Guidance note to BS 5750-2:1987: ISO 9002-1987/EN 29002-1987 Relating to the supply and erection of fences*

Other references

[1] GREAT BRITAIN. Health and Safety at Work etc. Act 1974. London: HMSO.

[2] *Traffic Signs Manual,* Chapter 8 *Traffic Safety Measures and Signs for Roadworks and Temporary Situations,* 1991. London: HMSO.

[3] *Safety at Roadworks — Notes for Guidance.* The County Surveyors Society, 1993.

[4] *Planning for Safety — Guidance Notes for the Health and Safety of Workers at In-Service Motorway Roadworks Sites.* Federation of Civil Engineering Contractors, 1992.

[5] GREAT BRITAIN. Control of Substances Hazardous to Health Regulations, 1988 (amended by no. 2026, 1990). London: HMSO.

[6] GREAT BRITAIN. Construction (Lifting Operations) Regulations 1961. London: HMSO.

[7] GREAT BRITAIN. Construction (General Provisions) Regulations 1961. London: HMSO.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL