

Guidelines for storage and handling BlueScope Steel's products



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1.0 Intent of this Publication

BlueScope Steel provides these guidelines to customers as an input into the customers' risk assessment process for storage and handling of coil, plate, sheet and long products supplied by BlueScope Steel.

These guidelines provide only a general guide to the safe storage and handling practice for BlueScope Steel supplied products. They are not intended to be nor should they be relied on as a substitute for technical and professional engineering advice regarding the safe storage and handling of steel products in the particular circumstances of individual customers.

These guidelines are subject to the Disclaimer and Conditions of Use provided on page 20. Please read the Disclaimer and Conditions of Use before using these guidelines.

Advice for a particular situation/site can be obtained by contacting your account manager at BlueScope Steel or an appropriately qualified engineer.

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2.0 Storage Methods

There are two broad categories of storage systems:

“Fully Engineered” Storage Systems

The term “Fully Engineered” covers a wide range of systems. These vary from methods as basic as fixed chocks, to simple racks and lock-in chock systems, to high volume racking. Due to the wide range of options, this document does not cover these systems. Seek advice from a qualified engineer based on the circumstances of your particular situation or site before implementing any “Fully Engineered” storage system.

“Procedural” Systems

The term “Procedural” refers to those systems that rely heavily on procedures to achieve safe storage. Procedural systems cover the storage of product on a suitable floor, secured using predominantly temporary (movable) supports such as wooden chocks and dunnage.

This document provides detail on procedural storage methods for different product types.

2.1 Objectives to Consider in Storage System Development

There are many objectives to consider when developing a storage system for a particular site. This document focuses on the following key objectives:

- Minimising the risk of unintentional product movement: rolling, toppling, sliding, coil collapse (due to poor coil integrity i.e. soft or tight bore), etc
- Maximising safety and ease of product handling (in and out of storage). This includes minimising interaction between pedestrians and both the stored steel product and the mobile equipment used to handle it*

While product quality, space and cost efficiencies are built into some of the alternative storage methods covered, the emphasis is on safe storage.

* Note that Procedural Systems often rely on people to place chocks and dunnage in close proximity to stored product and mobile equipment.

2.2 Prerequisites for Safe Storage

- Products should always be stored on a stable, clean, dry, flat and level surface that is not subject to flooding or wet conditions. A suitably qualified engineer should assess the load bearing capacity of the floor. The storage space should allow adequate access for personnel and machines involved in material handling
- BlueScope Steel does not recommend multi-high stacking of bore horizontal coils without site-specific advice from a qualified engineer. Customers should not rely on this document for guidance in relation to multi-high stacking of bore horizontal coils
- Before storing product in earthquake prone areas (e.g. New Zealand) a qualified engineer should review the proposed storage arrangements. The recommendations in this document should not be adopted without confirmation from the engineer that they are appropriate for earthquake prone areas
- The correct chocking and stacking procedures should be followed at all times

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2.2 Prerequisites for Safe Storage (continued)

Strapping

- Strapping and the leading edge of some coils can be sources of stored energy and can spring out when cut or released
- Strapping on coils and packs may have sharp edges, particularly if the strapping is made from steel
- A Standard Operating Procedure (SOP) should be in place for cutting and handling strapping. The SOP should consider the potential for release of stored energy, the position of people (e.g. standing to the side when cutting), tools (e.g. using long handled cutters), the order in which straps are cut (i.e. bore or circumferential first) and PPE (e.g. cut resistant gloves, arm-guards and face shield)
- Strapping on coils and packs should remain in place until the product is ready for use. In this document, strapping has only been omitted from the illustrations for clarity

2.3 Summary of Requirements

The following points summarise the requirements for the storage and handling of products. More detailed descriptions of the requirements can be found later in this document.

All Products

- Handling equipment should be certified to the appropriate local or international standard
- Safe Working Load (SWL) and maximum product dimensions that can be handled should be displayed on handling equipment
- Handling equipment should be designed or modified (and recertified) to prevent or reduce the unintended movement of product
- Procedures should be in place describing lifting methods and equipment to be used
- Risk assessments should be conducted on material handling activities
- Risk assessments should include unintended movement of product during handling

- Coils that are clock-sprung, 'soft' or egg shaped and poor integrity packs including those with broken straps or loose packaging, should not be stored or handled without a Standard Operating Procedure (SOP) or Job Safety and Environment Analysis (JSEA)

- Personnel should be trained in storage and handling operating procedures

Bore Horizontal Coils

- Coils with a diameter to sheet width ratio greater than 2.5:1 should not be stored bore horizontal without site-specific engineering advice
- Chock design should be engineered and certified
- Coils should be placed centrally on chocks
- Coils should be placed square and central in row
- All row ends should be chocked
- Fixed chocks should be used for row ends adjacent to high-risk areas
- Subsets of coils in a row should have end coils chocked

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2.3 Summary of Requirements (continued)

Bore Vertical Coil

- The maximum stack height to width ratio should be 5:1, with a maximum stack height of 3.3 metres
- Coils should be stacked centrally above each other. The maximum offset allowed should be no more than 25mm
- The diameter of the top coil should be the same or less than the coil below it
- Dunnage length should be less than the coil diameter and of a uniform cross sectional size
- Dunnage should be equally spaced under the coil
- Coil should be placed centrally on the pallet

Plate and Sheet Packs (flat steel and roll formed)

- All individual packs should be symmetrical and stable
- Dunnage supporting packs should be symmetrical and of adequate size to allow lifting/handling (nominally 75 x 75mm)
- Dunnage spacing should be nominally 900mm for transverse placement and 700mm for longitudinal placement
- Dunnage in stacks should be aligned
- Maximum stack height for packs between 100mm and 600mm wide should be twice the smallest support dimension
- Maximum stack height for packs greater than 600mm wide should be two and a half times the smallest support dimension
- Larger packs should not be stored on top of packs with smaller dimensions in either width or length
- Sheet or plate less than 100mm wide requires a site specific engineered storage solution

Plate (including plain plate, floor plate, Q&T plate)

- Plate should be stored flat/horizontally on level ground
- Plate should not be stored on its edge without site specific engineering advice and engineered racks
- Larger plate should not be stored on top of plate with smaller dimensions in either width or length
- Dunnage should be spaced to fully support plate
- Do not lift packs of plate with a magnet, as the packing straps are not designed to support the weight of the pack

Long Products (rod, bar etc)

- Long products should be stored on level ground and so that unintended movement is avoided
- Long products should not be stored as loose (un-bundled) product on top of each other without restraints to prevent movement. Site specific engineering advice should be obtained
- Do not lift bundles with a magnet, as the packing straps are not designed to support the weight of the bundle
- All beams and columns should be stored web horizontal

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3.0 Procedural Storage Systems

General

This section covers methods for storage of product on a suitable floor, secured using temporary supports such as wooden chocks and dunnage.

Although referred to as Procedural Systems, engineering input is recommended, and in some cases necessary, to ensure safety in the individual customer's circumstances. Chocks and dunnage should be of an engineer certified design. Examples are included in section 3.1.

It is highly recommended that the guidelines contained in this document are assessed for relevance to the individual customer's circumstances and site characteristics and procedures that take into account those circumstances and characteristics be developed.

3.1 Coils – Bore Horizontal

3.1.1 Multi-High Procedural Storage

BlueScope Steel does not recommend bore horizontal, multi-high storage using procedural systems (i.e. two or three high storage of bore horizontal coils using loose wooden chocks for restraint) due to the increased risk of this storage method.

Factors that can cause multi-high bore horizontal storage collapse.

- Insufficient, lack of or inaccurate placement of coil chocks
- Failure to use either adequate end-stops or a properly designed chock to constrain coil product
- Improper floor surface e.g. painted, oily, uneven, not level or very smooth concrete, use of conveyor belting, sand or dirt on concrete surfaces

- Stacking over two-high and relying on an inadequate means of coil support
- Base coils too far apart
- Excessive variation in base coil diameters
- Placing larger diameter coils on top of smaller diameter coils
- "Shock Loading" during the stacking process i.e. lowering the second row coils down heavily onto the bottom row coils

Contact BlueScope Steel or a suitably qualified engineer for site-specific specialist advice.

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3.1.2 Single-High Coil Storage

BlueScope Steel recommends single-high storage, as it is the lowest risk storage method for all forms of product. It is the most common system, and the least sensitive to procedural breakdowns. In particular, single-high storage is strongly recommended in the following circumstances:

- For coils which are clock sprung or which have broken straps or loose packaging
- For electrical steel
- If dunnage (longitudinal) is used to keep coils off the floor

Single high storage removes the risk of multi-high collapse. However, there remains a risk that coils may roll or tip over due to floor slope or inadvertent push from coil handling activities. All coils should be restrained using the methods described in this section and utilising the appropriate chock design detailed in section 3.1.2d - Recommended Moveable Chock Details.

Single-high is also the recommended option for reducing the risk of product and pack damage.

a. Coil Height to Width Ratio

A recommended coil height (outside diameter) to width ratio of 2.5:1 is a critical item in designing safe storage. While the majority of this section deals with storage of bore horizontal 'wide' coil, the first section deals with storage of coils with height to width ratio of more than 2.5:1, in particular very narrow coils.

b. Narrow Coils

Narrow coils with height to width ratios greater than 2.5:1 present an unacceptably high risk (particularly of toppling over) when stored bore horizontal as a stand-alone coil. An engineered solution (such as support posts or racks) should be utilised or the coils should be down-ended to bore vertical, or be bundled (strapped) together for storage. If narrow coils are to be stored bore horizontal then they should be stored in racking that supports the coil on each side above its centre (Figure 1).

Handling of narrow coils also involves a high level of risk. Site specific procedures should be developed to identify and address risk and provide instructions for safe handling to operators.

The breaking up of consolidated packs or mults of narrow coils should only ever be carried out in a designated (engineered) rack (Figure 2) or area for doing this particular task.

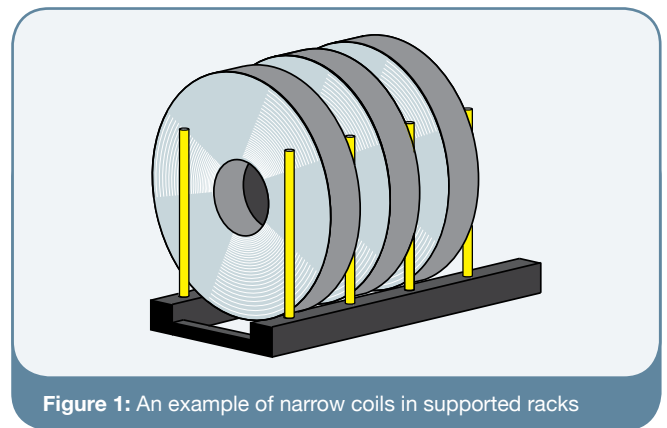


Figure 1: An example of narrow coils in supported racks



Figure 2: A rack used for separating narrow coils

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3.1.2 Single-High Coil Storage (continued)

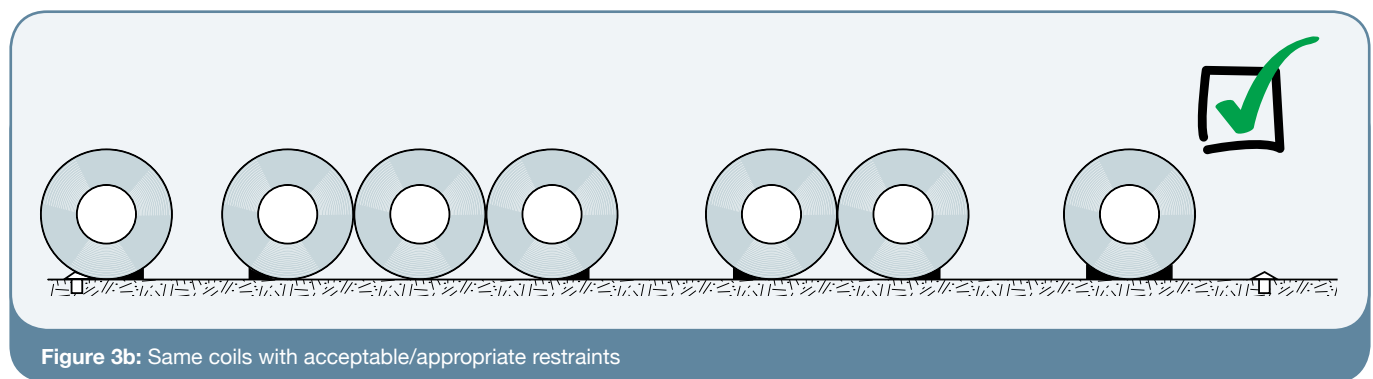
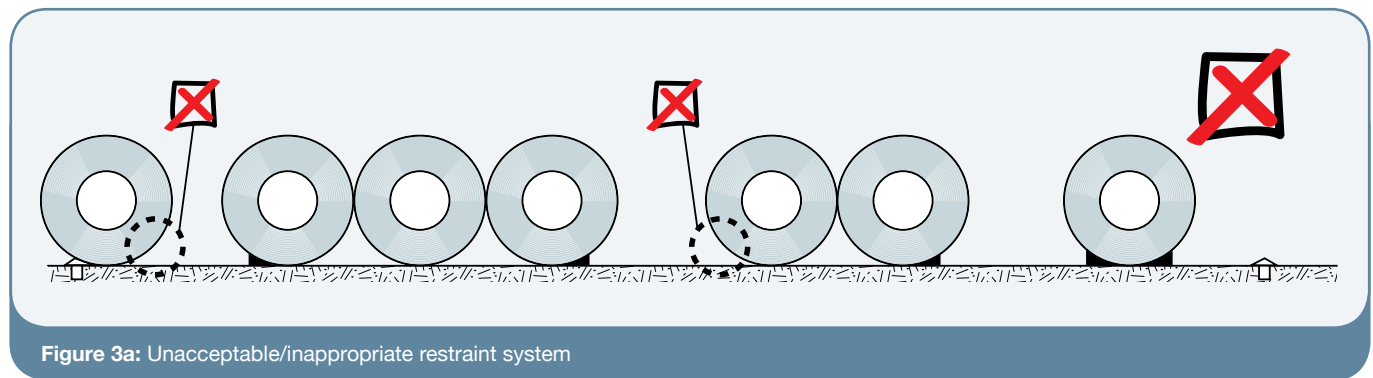
c. Coil Restraint

All bore horizontal coils being stored, whether temporarily, short term, or long term, should be restrained in some way to prevent movement. Recommended methods of restraint are set out below.

In all high-risk areas, where coil rows run at 90° to pedestrian and traffic ways, a fixed chock system should be installed to restrain the row (for an example, see Figure 3b).

A **high-risk area** is any pedestrian or traffic pathway (regardless of frequency or exposure), toilets, offices, work-stations etc.

Where installation of permanent, fixed-chock systems is not allowed/desirable (eg leased warehouses), some type of semi-permanent system should be installed.



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3.1.2 Single-High Coil Storage (continued)

The most suitable chock for coils is a function of the coil sizes and floor condition. (see Section d - Recommended Moveable Chock Details below).

The chock should be placed centrally and used with the diagonal side bearing against the coil. This allows a vertical face to be used to forcefully place the chock in the nip between the floor and coil circumference (see Figure 4a).

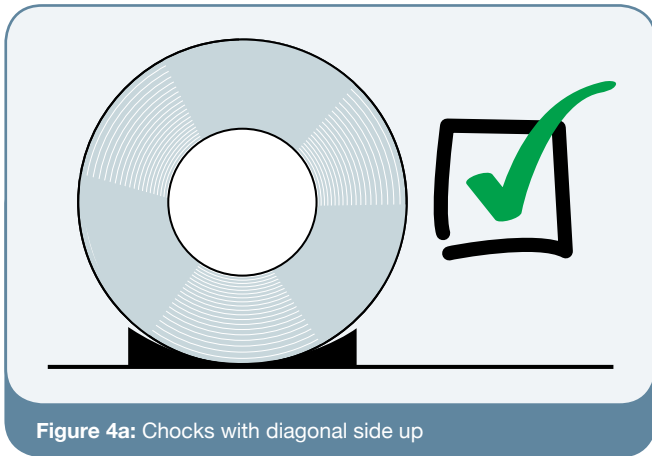


Figure 4a: Chocks with diagonal side up

Alternatively, the chock may be placed with the diagonal face down. Provided that the chock is correctly chosen it makes no difference other than the ease with which the chock can be wedged into place (see Figure 4b).

Care should be taken to ensure that coils are placed square and centrally in plan view.

Coils should be stored at all times so that all strap joiners are not in contact with either the floor or another coil.

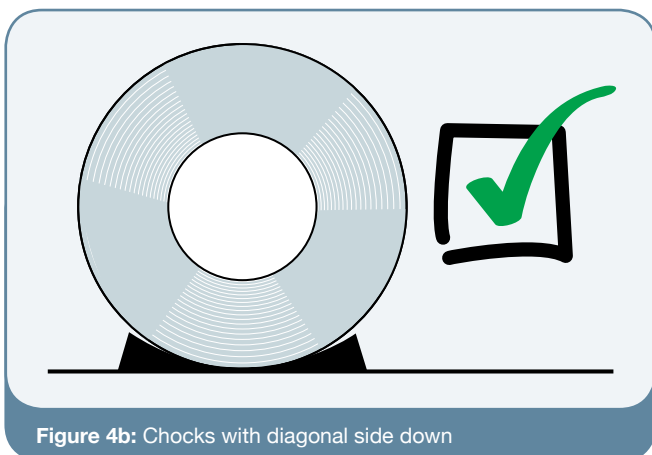


Figure 4b: Chocks with diagonal side down

d. Recommended Moveable Chock Details

Following is a moveable chock design based on a concrete floor with wood float finish, in good condition, using F11 grade Hardwood (F11 grade hardwood is determined using AS2082).

If this material is not available, then an engineer should recommend a suitable alternative material that will meet, match or exceed this specification – particularly in relation to compressive and shear loading involved.

Type A3 Standard Moveable Chock, Single High Coil Storage

- Suitable for coils up to a maximum of 1510mm diameter diagonal face up; or 1620mm diameter, diagonal face down
- F11 Grade Hardwood
- Minimum Chock Length (Z): 600mm for coils up to 1200mm wide; 900mm for coils up to 1850mm wide
- Preferred chock length is 900mm or longer to suit the widest coils stored
- 21 degrees is the desired angle on the face
- Height (Y) = 57mm + X (recommended X = 10mm)
- Tolerances: Y maximum = 60mm + X
Y minimum = 54mm + X

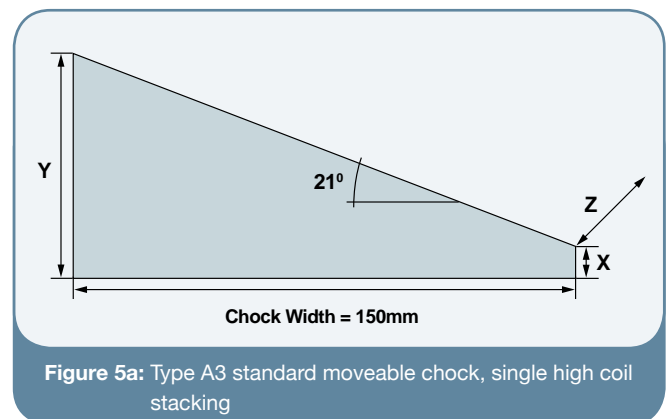


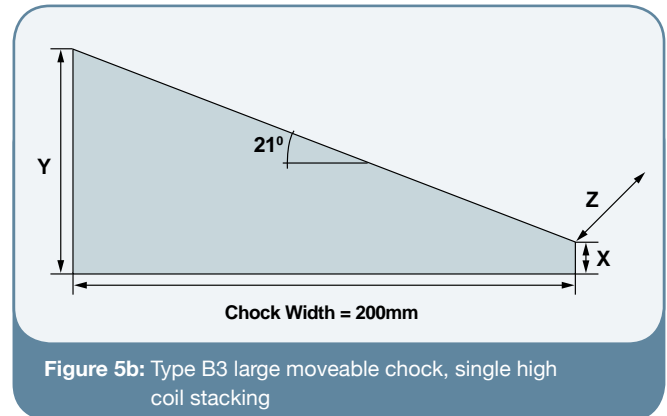
Figure 5a: Type A3 standard moveable chock, single high coil stacking

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3.1.2 Single-High Coil Storage (continued)

Type B3 Standard Moveable Chock, Single High Coil Stacking

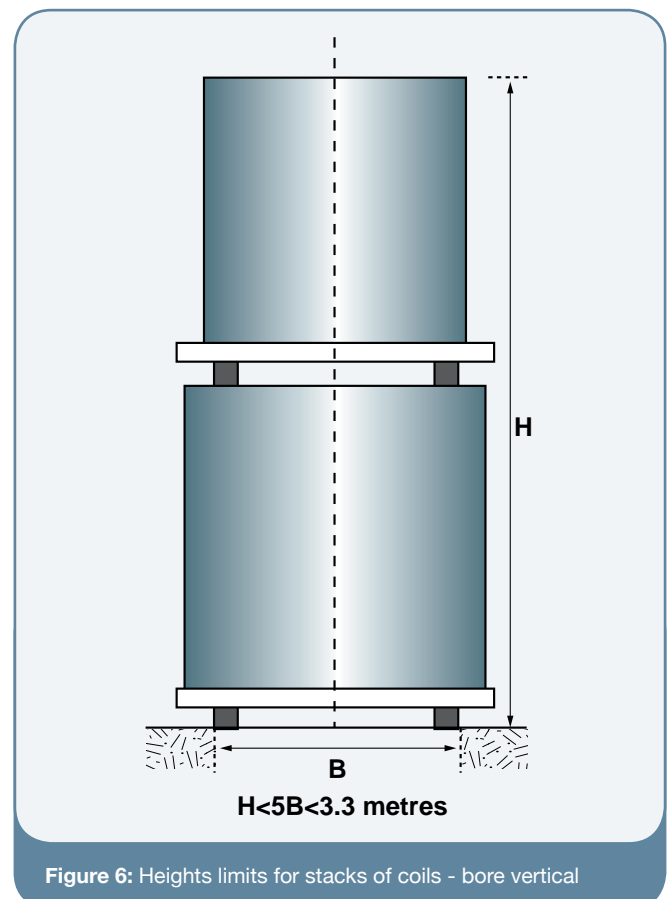
- Suitable for coils up to a maximum of 2010mm diameter diagonal face up; or 2160mm diameter, diagonal face down
- F11 Grade Hardwood
- Minimum Chock Length (Z): 600mm for coils up to 1200mm wide; 900mm for coils up to 1850mm wide
- 21 degrees is the desired angle on the face
- Height (Y) = 77mm + X (recommended X = 10mm)
- Tolerances: Y maximum = 80mm + X
Y minimum = 74mm + X



3.2 Coils – Bore Vertical

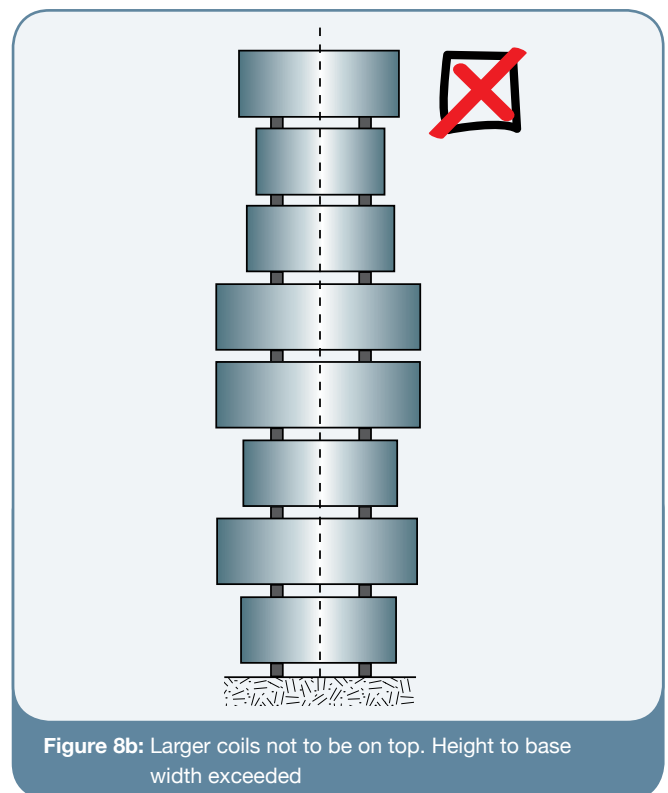
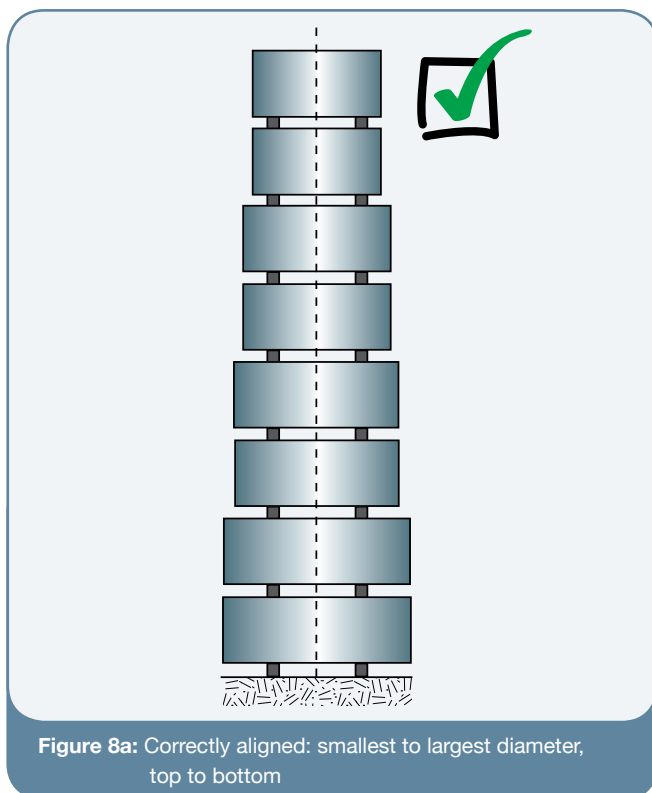
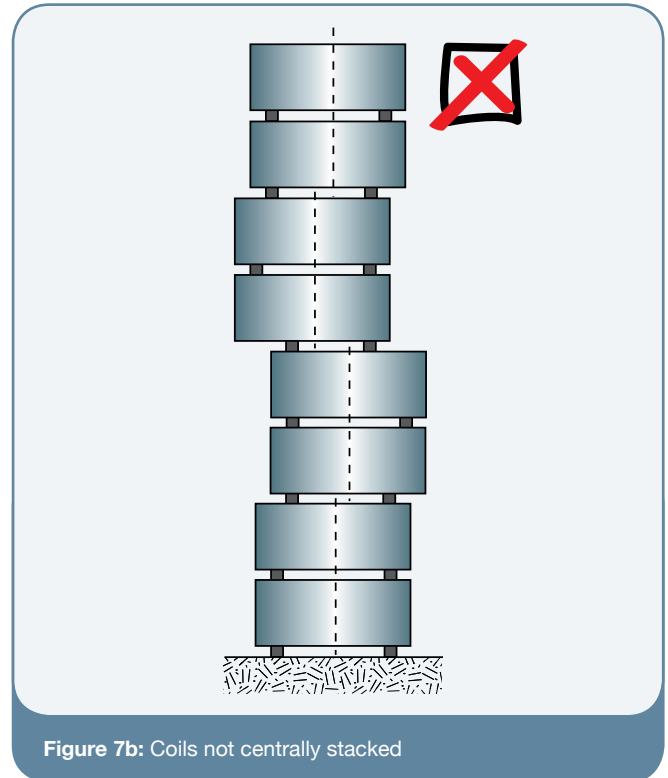
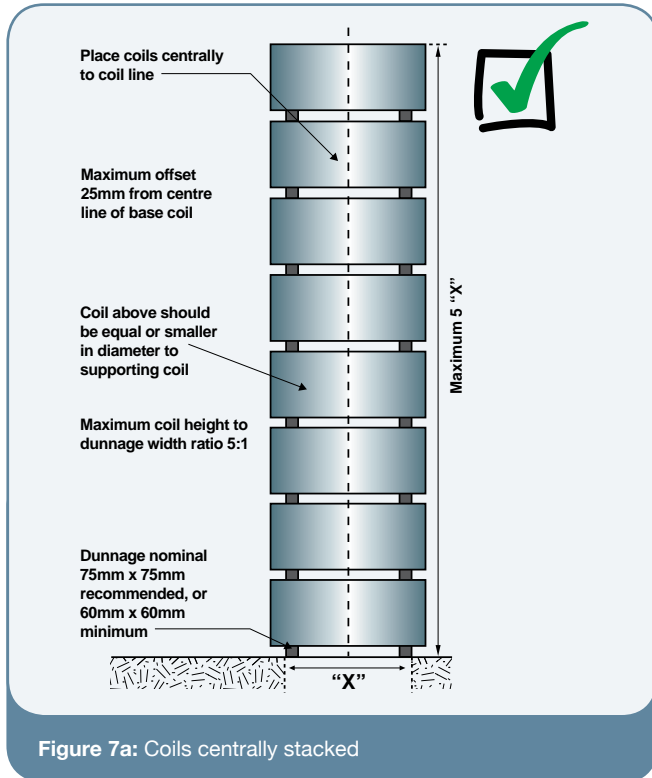
The maximum stack height to width ratio should be 5:1, to a maximum height of 3.3 metres (see Figure 6). The width referred to is the overall distance between the outside of both supports (either the dunnage or pallet bearers).

- Coil separators or dunnage should be hardwood, with the following requirements:
 - Length should be less than coil diameter
 - Should be uniform in size (nominal 75mm x 75mm preferred, 60mm x 60mm acceptable)
 - Should be equally spaced
- Coils should be stacked centrally above each other
- The maximum offset allowed, between the centreline of the base coil, should be no more than 25mm
- The diameter of the coil above should be equal to, or smaller than, the coil below



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3.2 Coils – Bore Vertical (continued)



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3.2 Coils – Bore Vertical (continued)

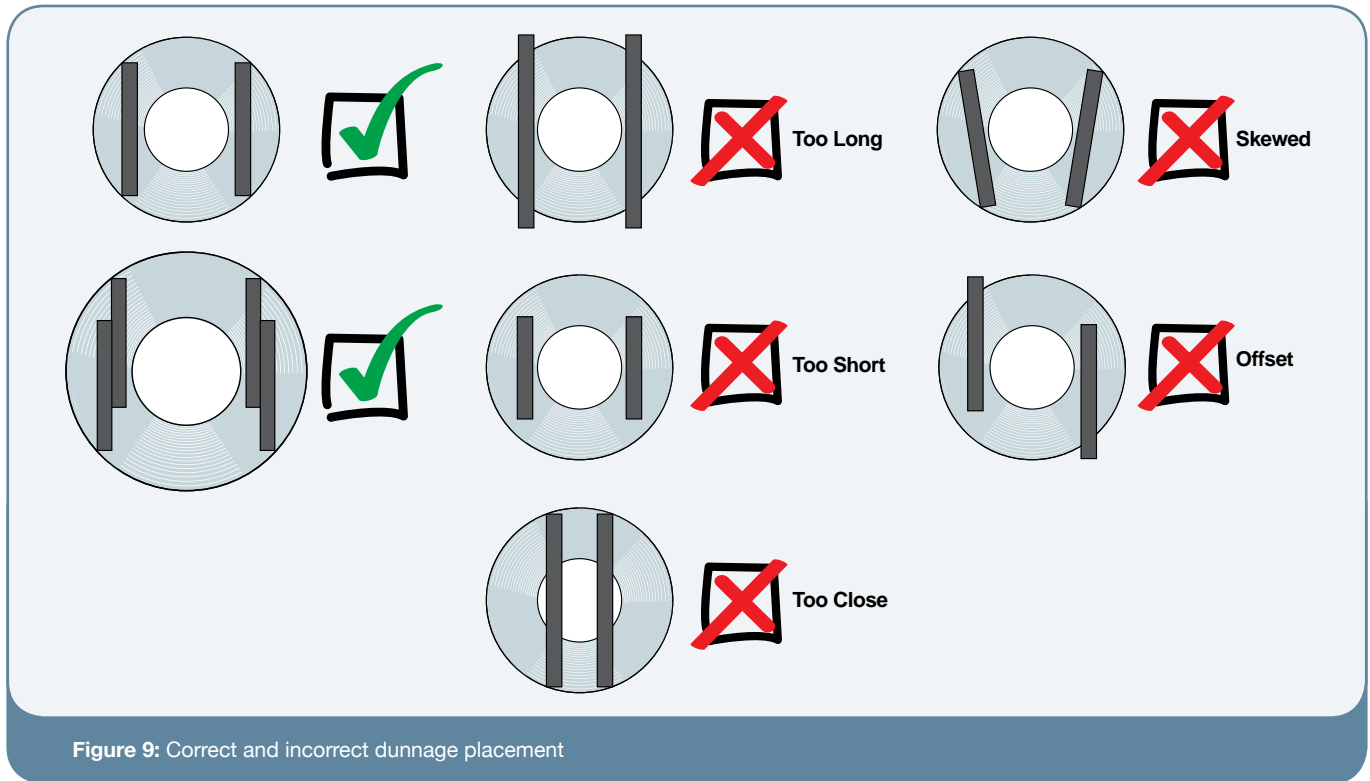


Figure 9: Correct and incorrect dunnage placement

3.3 Plate and Sheet Packs (roll formed and flat steel)

This section applies to product normally handled in sheet pack form. Additional information for large, heavy plate is also included.

All individual packs should be symmetrical and stable.

Dunnage of hardwood or metal should be placed between bundles of sheets or frames (stillages) placed under packs to facilitate lifting. Dunnage should be symmetrical and of sufficient size to allow safe use of lifting/handling gear. Generally 75mm x 75mm is the preferred dunnage size but nominal 60mm x 60mm hardwood may be acceptable in some cases. Site specific engineering advice should be obtained.

Dunnage can be placed in either a transverse or longitudinal direction, depending on the lifting gear being used. Dunnage spacing is nominally 900mm for transverse placement and 700mm for longitudinal placement.

Maximum Height

To ensure pack and/or stack stability, the pack and/or stack height is limited to a multiple of the Narrowest Support Dimension throughout the whole stack (see Figure 10).

This multiple depends on the sheet or plate width as specified below:

= 2.0 x Narrowest Support Dimension for sheet/plate that is 100 - 600mm wide

= 2.5 x Narrowest Support Dimension for sheet/plate that is wider than 600mm

Note: Sheet/plate that is less than 100mm wide needs a site-specific engineered system.

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3.3 Plate and Sheet Packs (roll formed and flat steel) (continued)

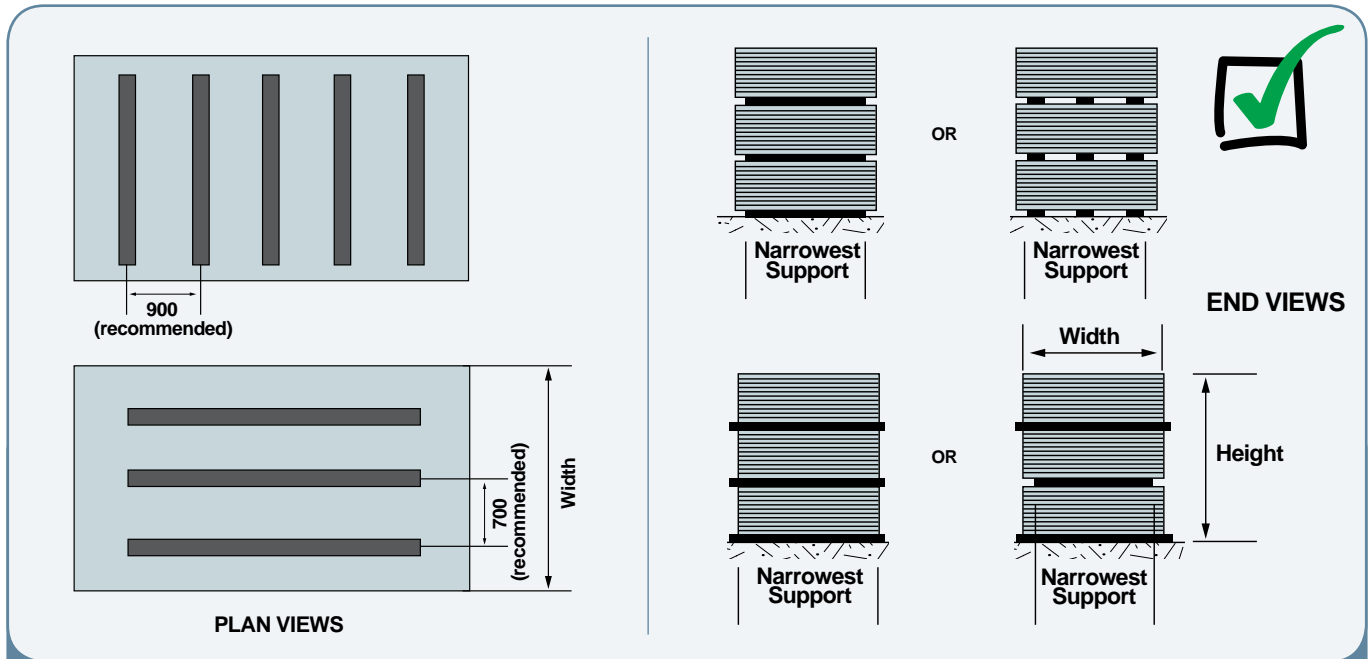


Figure 10: Dunnage placement and stack height

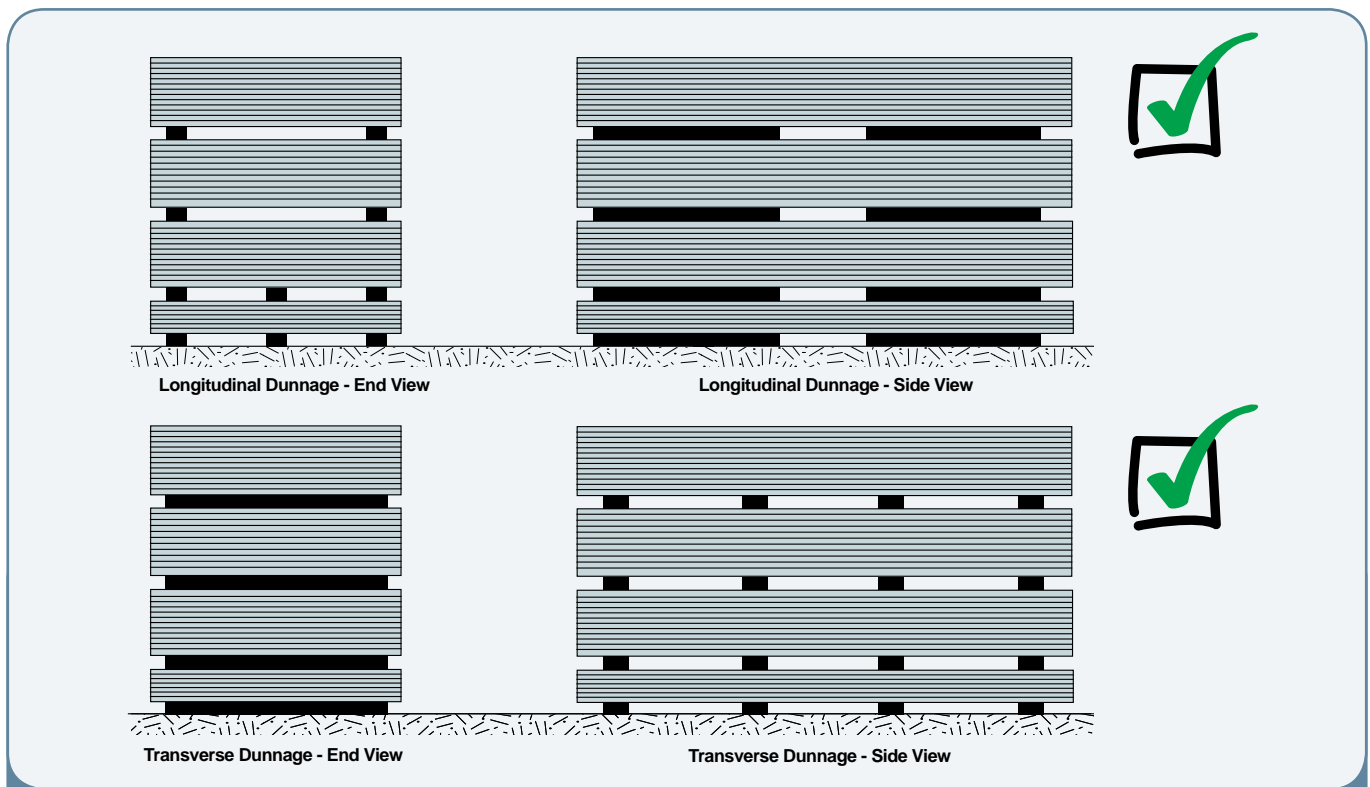


Figure 11a: Correct dunnage placement

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3.3 Plate and Sheet Packs (roll formed and flat steel) (continued)

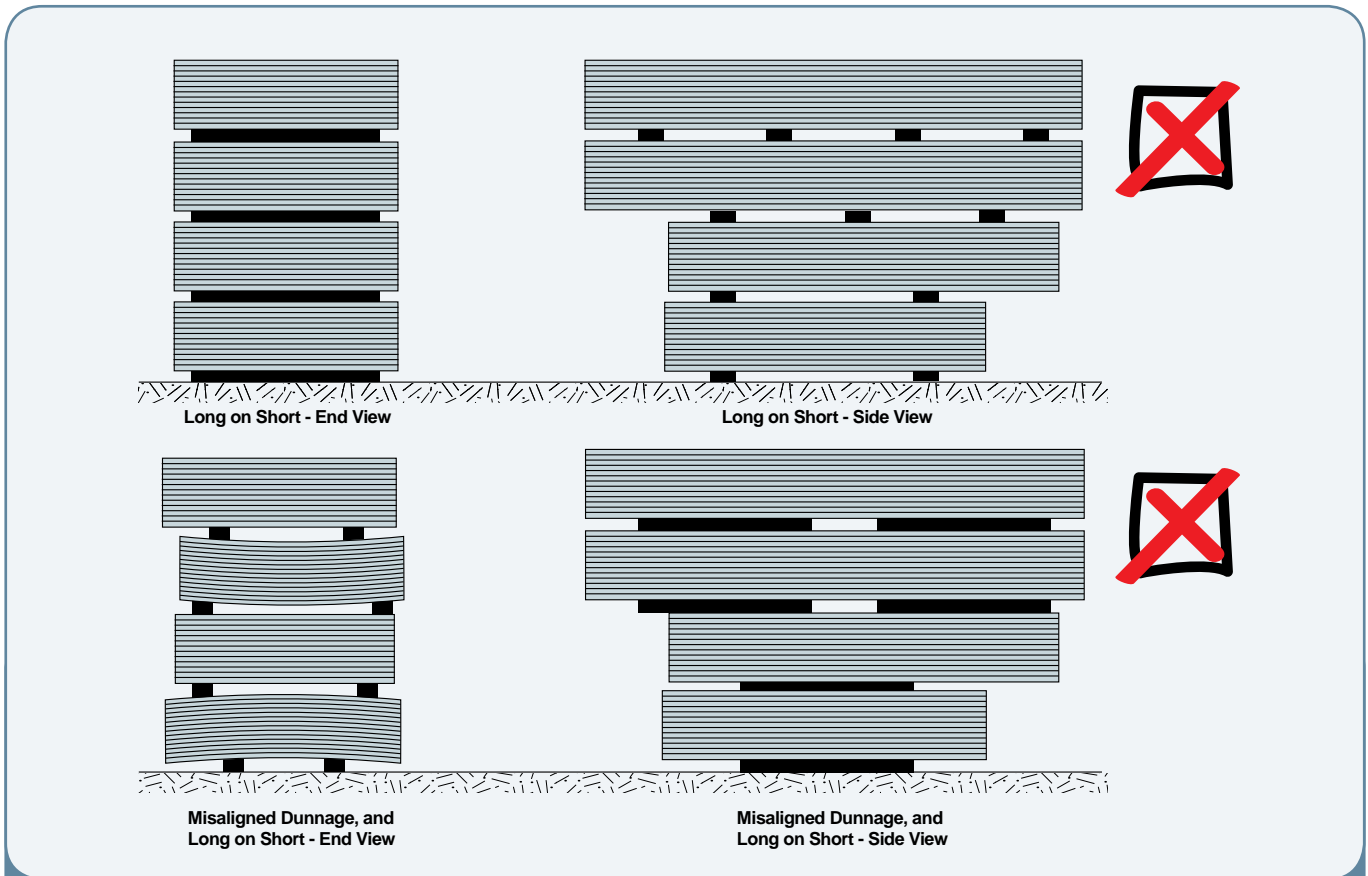


Figure 11b: Incorrect stacking and dunnage placement

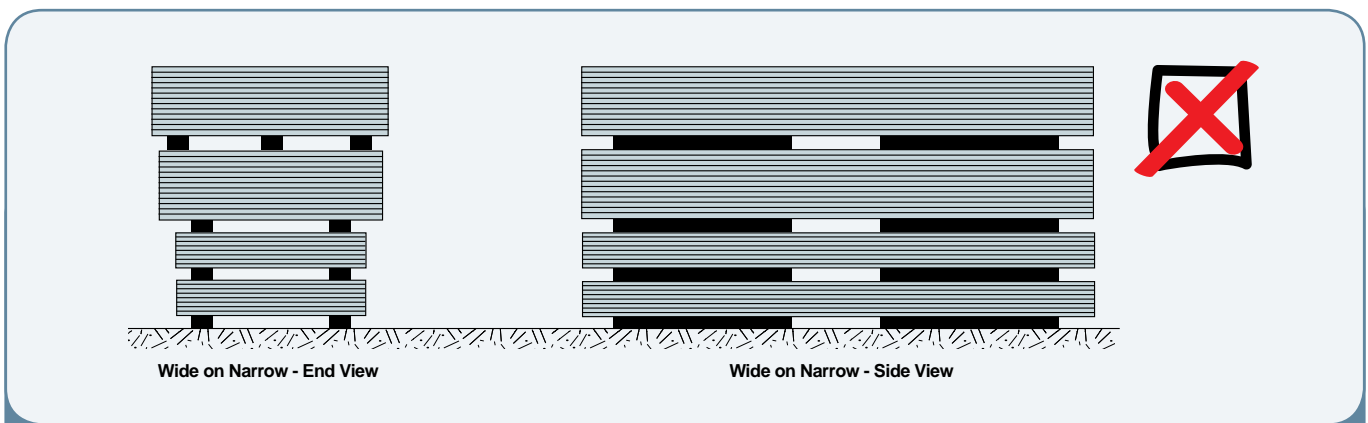


Figure 11c: Incorrect stack construction

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3.3 Plate and Sheet Packs (roll formed and flat steel) (continued)

Large plate

Wide, long or heavy gauge plate (including plain plate, floor plate, Q&T plate)

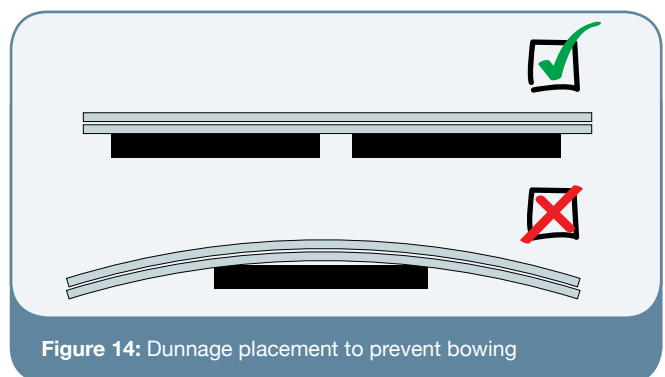
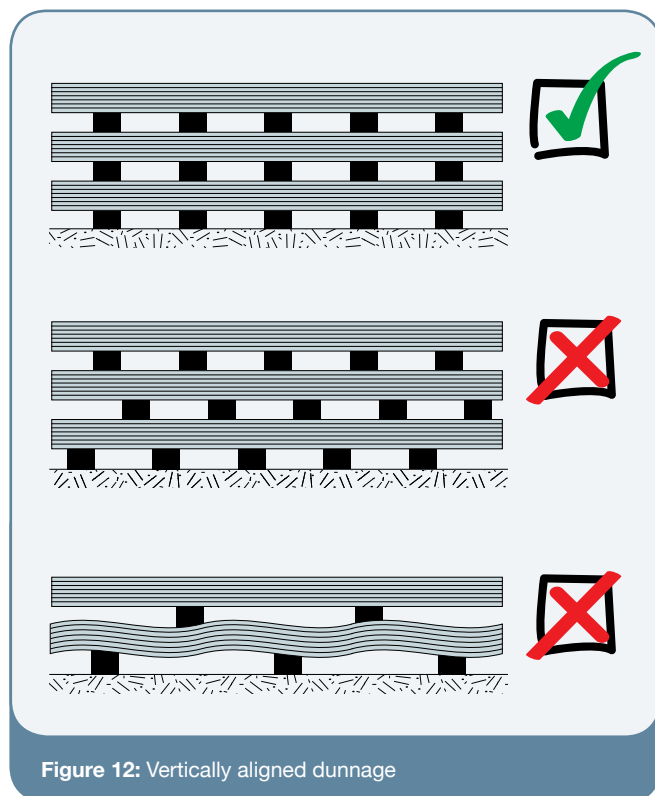
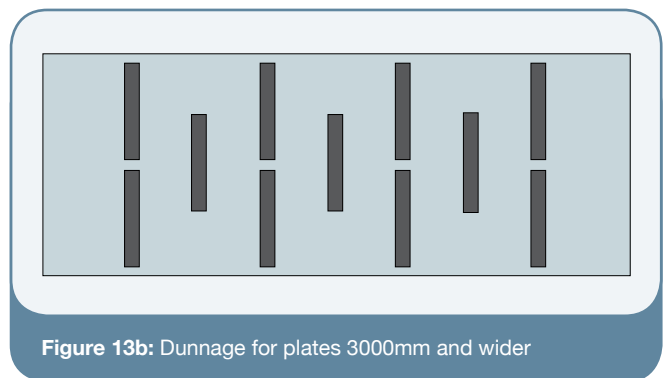
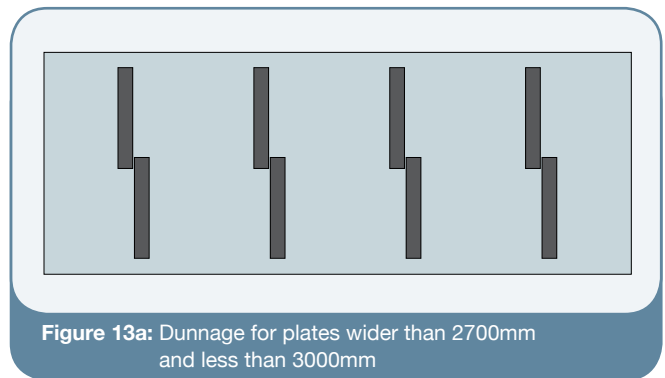
- Plate should be stored flat / horizontally on level ground
- Plate should not be stored on its edge without site specific engineering advice and engineered racks
- Larger plate should not be stored on top of plate with smaller dimensions in either width or length
- Dunnage should be spaced to fully support plate
- Dunnage should be nominally 75mm x 75mm however 60mm x 60mm may be acceptable in some cases, subject to risk assessment

Sharp edges of sheared plate and small slivers of scrap can cause injury. Appropriate cut resistant gloves should be worn when handling plate or scrap.

Plates on the floor can also be a trip hazard. Customers should develop site-specific procedures to address this risk.

Dunnage

- Dunnage should be vertically aligned within the stack when loading or stacking
- For light gauge plate, place dunnage as shown in Figures 13a and 13b
- When storing wide plates it may be necessary to use two pieces of dunnage in each row to stop the plates from bowing



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3.3 Sheet Packs and Heavy Plate (roll formed and flat steel) (continued)

Lifting plate packs

Pre-packed bundles, strapped together, should not be lifted by magnet as the strapping is not designed to hold the load of the entire bundle and would be in danger of snapping if exposed to the entire weight of the pack.

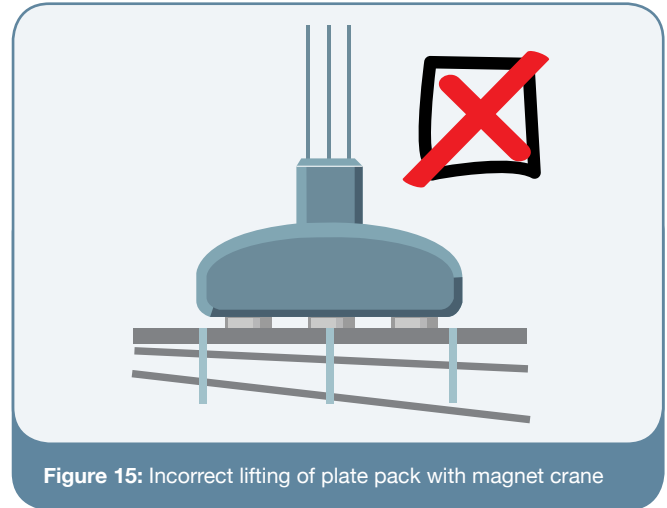


Figure 15: Incorrect lifting of plate pack with magnet crane

3.4 Mesh Products

- Mesh products should not be stored in stacks more than 1800mm high
- Mesh should be stored flat / horizontally on level ground
- Mesh should not be stored on its side without site specific engineering advice and engineered racks
- Larger sheets of mesh should not be stored on top of sheets with smaller dimensions in either width or length
- Space dunnage to fully support mesh
- Dunnage should be nominally 75mm x 75mm however 60mm x 60mm may be acceptable in some cases, subject to risk assessment
- Dunnage should be vertically aligned within the stack when loading or stacking
- A height to width ratio should be used as mesh is not always in a large sheet
- Sharp edges of mesh can cause injury. Appropriate cut resistant gloves should be worn when handling plate or scrap
- Mesh on the floor can also be a trip hazard. Customers should develop site-specific procedures to address this risk

3.5 Long Products (rod, bar, beams, columns etc)

- Long products should be stored on level ground and so that unintended movement is avoided
- Long products should not be stored as loose (un-bundled) product on top of each other without restraints to prevent movement. Site specific engineering advice should be obtained
- Product placed adjacent to walkways, work areas and driveways should be stored in a way that prevents unintended movement especially into high-risk areas. Site specific engineering advice should be obtained for high risk areas
- Do not lift bundles or packs with a magnet as the straps are not designed to support the weight of the pack / bundle
- Beams and columns should be stored web horizontal

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3.5 Long Products (continued)

Engineered storage

- Racks and racking systems are sometimes utilized to store a range of products including plate, structural, tube, merchant bar and other special steel products. These systems depend on site specific engineering advice and are not covered in these guidelines

Strapped bundles:

- Long products should be left strapped in original manufacturer straps for storage
- Cut and remove the straps located in the middle of the load first and leave the strapping located nearest to the ends of the load to last
- CAUTION: When cutting tensioned strapping, beware of recoiling strapping and stored energy within product. Steel strapping also poses a cut risk and correctly fitting cut resistant gloves should be worn when handling it

Stacking

- Cylindrical shapes such as heavy round bar, pipes, etc. should be chocked to prevent product from rolling
- All products except flat bar, round bar and tubular products should be interlocked at all times

Beams, Columns and Frames

- Product should be stored in a stable and uniform manner as per these guidelines
- Product should be stored on hardwood dunnage only
- Frames and beams should be stored in the horizontal position (Figure 16)
- Horizontal storage can either be free-standing stacks or contained by some form of engineered racking based on site specific advice
- Stacks refer to free standing product without any form of containment

- Stack frames and beams with the widest on the bottom and the narrowest on top (Figure 17)
- Stack frames and beams with the longest on the bottom and the shortest on top (Figure 18)
- Align stacks of beams centrally (Figure 19)
- Products that are stored in stacks should not exceed 2.0m in height unless magnet access is available

Maximum height for a freestanding stack is:

- 2 x the widest width for frames and beams between 100 and 600 mm wide

- 2.5 x the widest width for frames and beams wider than 600 mm

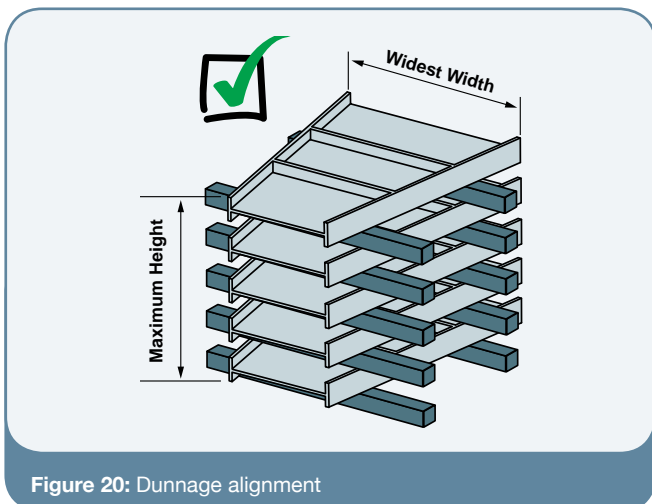
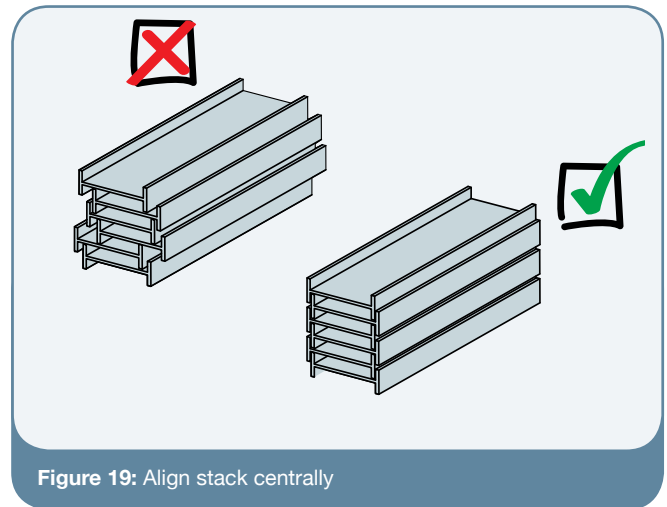
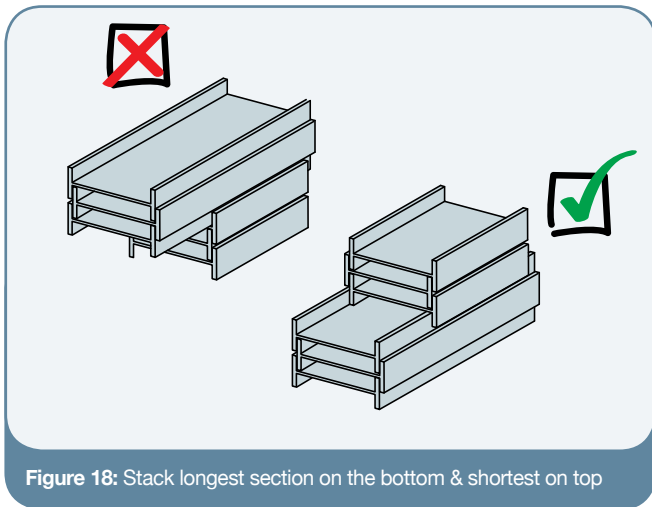
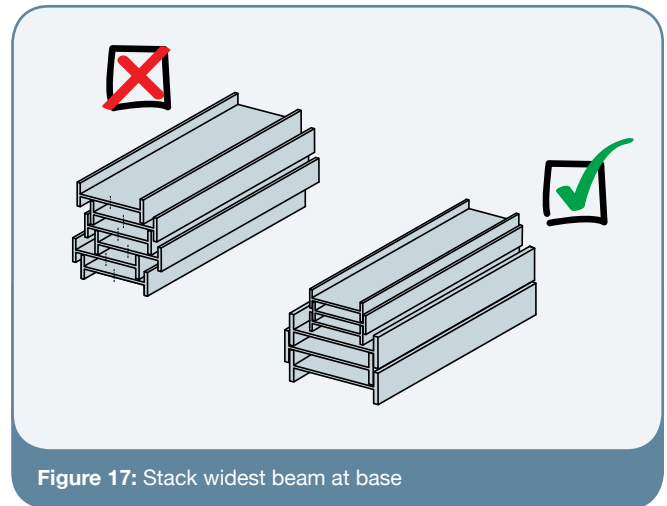
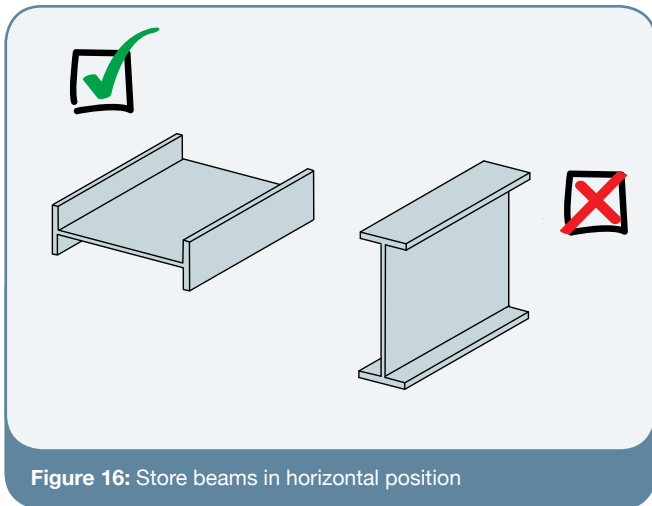
- Beams and frames less than 100mm wide should be stored in racks based on site specific engineering advice

When using timber dunnage between frames and beams:

- Dunnage should be 100mm x 100mm hardwood and should be of sufficient length to go across the width of the stack. Small section timbers are likely to break due to point loading
- Dunnage should be inspected prior to use and disposed of immediately if unsound
- Minimum two lengths of dunnage between each layer up to 10 tonnes of product in the total stack. Additional dunnage may be required under the bottom row to distribute the weight when storing on surfaces such as sand or asphalt
- One additional length of dunnage between each layer for every 5 tonnes of product in the stack thereafter
- To prevent the dunnage splitting, the edge of the frame or beam should not be within 20mm of the end of the dunnage
- To prevent dunnage breaking, no frame or beam should be supported on an overhanging piece of dunnage
- Dunnage should be vertically aligned within the stack

Guidelines for storage and handling BlueScope Steel's products

3.5 Long Products (continued)





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