Storage and handling guidelines
Revision 1, March 2024

BlueScope

Storage and handling of BlueScope products

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1 Intent of this publication

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

Guidance on storage of some other products may be referenced, however these and other downstream products often require complex or engineered solutions beyond the scope of the document. Likewise, safe handling of any steel product requires site-specific training and procedures to address the variety of handling, movement and lifting techniques throughout the industry.

These guidelines provide only a general guide to the safe storage and handling practice of BlueScope-supplied steel 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 22. Please read the Disclaimer and Conditions of Use before using these guidelines.

Strapping has been omitted from illustrations throughout these guidelines for clarity. Illustrations are not to scale.

2 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 situation or site before implementing any fully engineered storage system.

Fully engineered storage systems are preferred as they utilise fixed supports and are designed to prevent unintentional product movement and reduce risk of product damage.

'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 chocks and dunnage.

This document provides detail on procedural storage methods for different BlueScope 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.[1]

[1] Note that procedural systems often rely on people to place chocks and dunnage in close proximity to stored product and mobile equipment.

While product quality, space and cost efficiencies are built into some of the alternative storage methods covered, the emphasis is on safe storage (Section 2.2).

2.2 Pre-requisites 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. Prevention of storage-related corrosion should be considered and is discussed further in Section 4.

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. Areas assigned for storage should be clearly defined, showing row positions and storage boundaries. Adequate clearance must be provided around firefighting and prevention equipment, designated safety accesses, electrical and mechanical equipment, and as necessary to meet all other statutory requirements.

BlueScope 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, 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 (refer to Section 3).

Handling equipment should be designed to prevent or reduce the unintended movement of product either when stationary or under movement and 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 and engineered storage solutions such as racking.

Procedures should be in place describing lifting methods and equipment to be used. Risk assessments should be conducted on product handling activities.

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 appropriate risk assessment.

Personnel should be trained and certified in storage and handling operating procedures.

Products outside the scope of this document (e.g. mesh) may be stored according to the principles of these guidelines but will require an appropriate risk assessment to be carried out which takes into account the specific interactions of those products with the premises at which they are to be stored.

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.

An 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 Personal Protective Equipment (PPE) (e.g. cut resistant gloves, arm guards and face shield). Engineering considerations should be given to the strapping strength and type of material.

Strapping on coils and packs should remain in place until the product is ready for use. In this document, strapping has been omitted from the illustrations for clarity.

Strapping should not be used for lifting coils and packs.

Storage components

Consideration should be given to the types of components used in storage, such as type of timber (strength-graded or Laminated Veneer Lumber (LVL)) or chocks used (engineering rubber or wooden), as well as the engineering aspects of the components such as crush strength and materials used. If using LVL dunnage, laminations should be horizontal and may require rubberization due to potential slipperiness of packaging relative to the dunnage.

Regular inspection should be conducted of all storage components with replacement of any broken or damaged components. Storage components should be regularly audited to ensure they meet necessary engineering and procedural requirements for the site storage and handling practices.

3 Procedural storage systems

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

Although referred to as procedural systems, engineering input is recommended and in some cases will be 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 that procedures which take into account those circumstances and characteristics be developed.

3.1 Coils – bore horizontal

3.1.1 Multi-high procedural storage

BlueScope 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 handling damage and stack collapse with this storage method. Multi-high storage systems require fully engineered storage solutions.

Factors that can cause bore horizontal multi-high 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
- Relying on an inadequate means of coil support
- Base coils positioned 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 a suitably qualified engineer for site-specific specialist advice if multi-high stacking.

3.1.2 Single-high coil storage

BlueScope 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. 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 an engineered solution or the methods described in this section and utilising the appropriate chock design detailed in Section 3.1.2d (Recommended moveable chock details).

Single-high storage is also the recommended option for reducing the risk of product and pack damage and maintaining good visibility and safety around coil fields.

(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 following section (3.1.2b) deals with storage of coils with height to width ratio of more than 2.5:1, in particular very narrow coils or slit/mult material.

(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 horizontally then they should be stored in appropriate racking that supports the coil on each side above its centre (Figure 1).

Handling of narrow coils also involves a high level of risk. Due to various combinations of site designs and lifting equipment, site specific procedures should be developed to identify and address risks when handling 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 assessed as appropriate for carrying out this particular task.

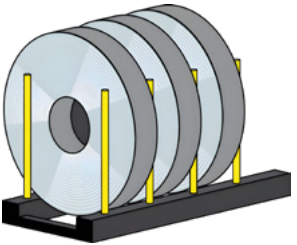

Figure 1. An example of narrow coils in supported racks.

Figure 2. A rack used for separating narrow coil.

(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, an engineered fixed chock or roll-block system should be installed to restrain the row (Figure 3). Fully engineered storage systems are preferred over wooden chocks as they utilise fixed supports and are designed to prevent unintentional product movement and reduce risk of product damage. The fixed chock must have an effective angle of 30° (28° is allowed for engineered racking), and support 60% of the coil width.

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

Where installation of permanent, fixed-chock systems is not permitted or reasonably practicable (e.g. leased warehouses), some type of semi-permanent system should be installed.

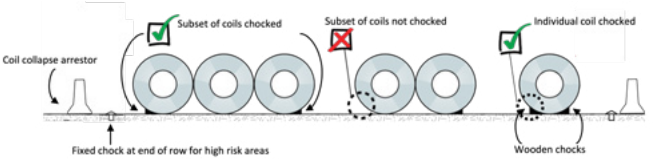

Figure 3. Coil restraint system showing acceptable and unacceptable chocking as well as roll-blocks at both ends of row.

The most suitable moveable chock for coils is a function of the coil size and floor condition (further detail in Section 3.1.2d below).

Care should be taken to ensure that coils are placed square and centrally along the row, and chocks used with the diagonal side bearing against the coil (Figure 4a) or along the floor (Figure 4b). This allows the chock vertical face to be forcefully placed in the nip between the floor and coil circumference.

Chocks should be periodically inspected and replaced if damaged.

Coils should be stored at all times so that none of the strap joiners are in contact with either the floor, chock or another coil.

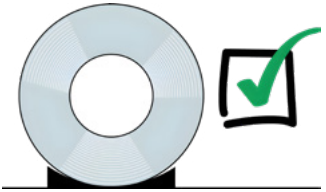

Figure 4a. Chocks with diagonal side up.

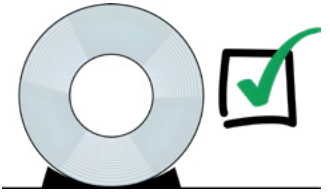

Figure 4b. Chocks with diagonal side down.

(d) Recommended moveable chock details

Moveable chock design should be engineered and certified. The following is a moveable chock design based on a concrete floor with wood float finish, in good condition, using F11 grade hardwood.[2]

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.

For coils of up to a maximum of 1510mm diameter with the chock diagonal face up, or up to a maximum of 1620mm diameter with the chock diagonal face down, the chock width (W) should be a **minimum of 150mm** and chock height (Y) should be a **minimum 67mm** (Figure 5).

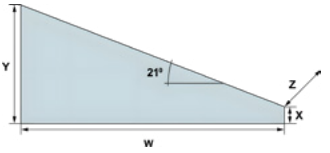

Figure 5. Moveable chock design, single high coil stacking.

For larger coils of up to a maximum of 2010mm diameter with the chock diagonal face up, or up to a maximum of 2160mm diameter with the chock diagonal face down, the chock width (W) should be a **minimum of 200mm** and chock height (Y) should be a **minimum 87mm** (Figure 5).

[2] F11 grade hardwood is determined using AS 2082-2007 Timber-Hardwood-Visually stress-graded for structural purposes.

For all coils:

A **minimum truncation (X)** of 10mm is recommended on the leading corner of the chock.

The minimum chock length (Z) should be **600mm for coils up to 1200mm wide**, or **900mm for coils up to 1800mm wide.**

The desired angle on the face of the chock is 21°.

3.2 Coils – bore vertical

The maximum stack height to width ratio should be 5:1, to a maximum height of 3.3 metres (Figure 6) however best practice is to single stack or store to a maximum of head height (i.e., 1.5m) to maximise visibility around coils. If multi-stacking coils, consideration is required to minimise potential for and consequence of a 'domino effect', where coil stacks may knock over a series of adjacent coils. Safe exclusion zones and engineering restrictions should be established for unforeseen events. Restricted access to coil fields is recommended and, in particular, attention to storage along walkways and thoroughfares.

The width (B) referred to is the overall distance between the outside of the narrowest support set (either the dunnage or pallet bearers).

Coil separators or dunnage should be hardwood, synthetic timber or Laminated Veneer Lumber (LVL) with the following requirements where needed (i.e. slit coils, not palletised bore vertical coils):

- Adequate length to support the coil, similar to the coil diameter and of a uniform cross-sectional size.
- Should be uniform in size (nominal 75mm x 75mm preferred; 60mm x 60mm acceptable).
- Should be equally spaced under the coil.
- Coils should be stacked centrally above each other (Figure 7a and b).
- 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 (Figure 8a and b).
- Suggestions of dunnage placement are provided in Figure 9.
- Regular inspection should be conducted of storage components and replacing broken or damaged components.

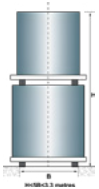

Figure 6. Heights limits for stacks of coils – bore vertical.

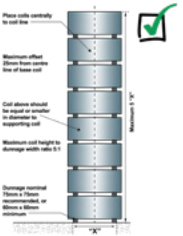

Figure 7a. Coils centrally stacked.

Figure 7b. Coils not centrally stacked.

Figure 8a. Correctly aligned: smallest to largest diameter, top to bottom.

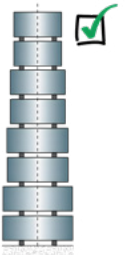

Figure 8b. Larger coils not to be on top, height to base width exceeded.

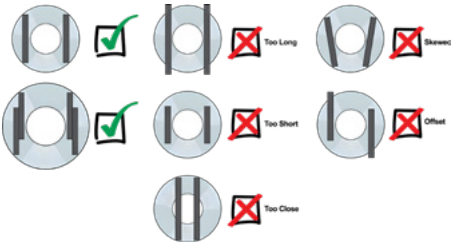

Figure 9. Correct and incorrect dunnage placement.

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 (Figure 10). Refer to Figures 11a, 11b and 11c for examples of correct and incorrect dunnage 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 (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/product that is less than 100mm wide needs a site-specific engineered system.

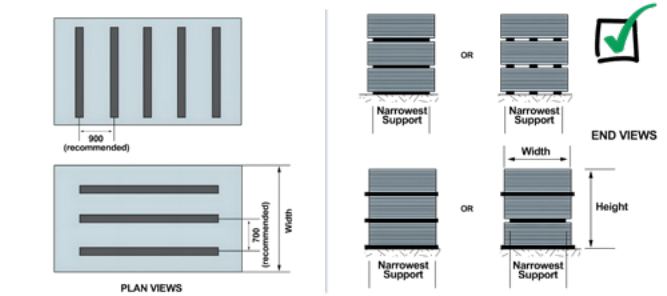

Figure 10. Dunnage placement and stack height.

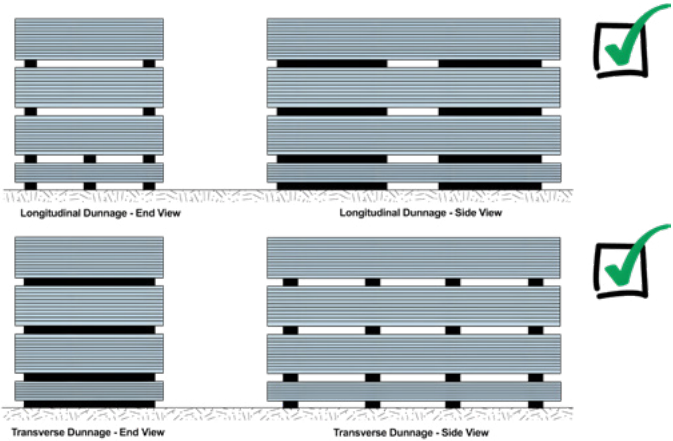

Figure 11a. Correct dunnage placement.

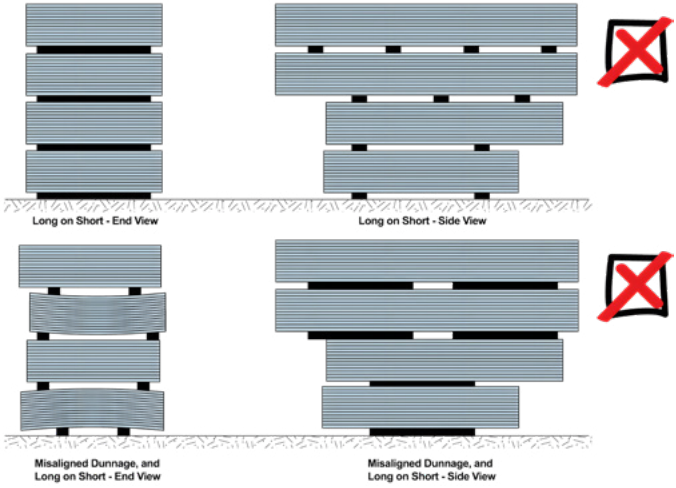

Figure 11b. Incorrect stacking and dunnage placement.

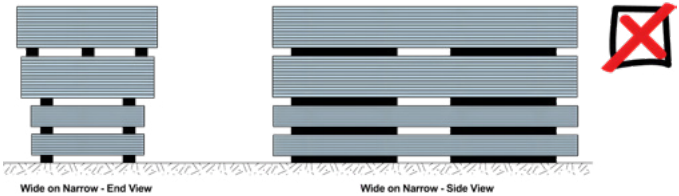

Figure 11c. Incorrect stack construction.

Large plate

For large, wide, long or heavy gauge plate (including plain plate, floor plate, quenched and tempered (Q&T) plate):

- Plate should be stored flat/horizontally on level footing off the 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 (Figure 12).

When storing wide plates, it may be necessary to use two pieces of dunnage in each row to stop the plates from bowing (Figure 13).

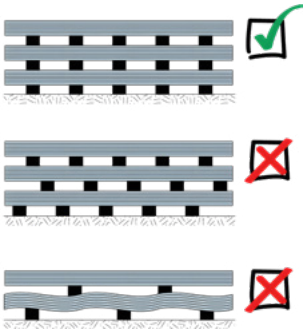

Figure 12. Vertically aligned dunnage.

Figure 13. Dunnage placement to prevent bowing.

For light gauge plate, place dunnage as shown in Figures 14a and 14b.

Figure 14a. Dunnage for plates wider than 2700m and less than 3000mm

Figure 14b. Dunnage for plates 3000mm and wider.

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).

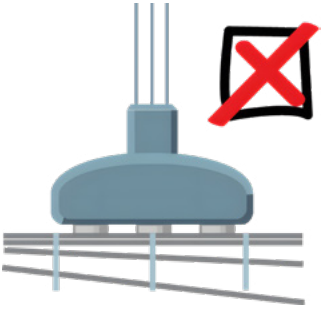

Figure 15. Incorrect lifting of plate pack with magnet crane

3.4 Long products (including rod, tube, bar, beams, columns)

- Long products should be stored level to avoid unintended movement.
- 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.

Engineered storage

- Racks and racking systems are sometimes utilised 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 until 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, arm guards and face shields should be worn when handling it.

Stacking

- Cylindrical shapes such as heavy round bar, tubes, 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

- Beams and columns should be stored web horizontal unless using a site-specific engineered storage solution.
- 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 (that is, without any form of containment) or contained by some form of engineered racking based on site specific advice.
- 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 600mm wide.
- 2.5 x the widest width for frames and beams wider than 600mm.
- Beams and frames less than 100mm wide should be stored in racks based on site specific engineering advice.
- The width of the stack can be considered the combined width of multiple beams when stored with full width dunnage between each layer.

When using timber dunnage between frames and beams:

- Dunnage should be minimum 75mm x 75mm 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 non-compressed or uneven surfaces.
- 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 end of 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.

If frames or beams must be stored vertically, they must be secured at all times.

End connection plates should not protrude more than the height of the dunnage or be used to support frame or beam.

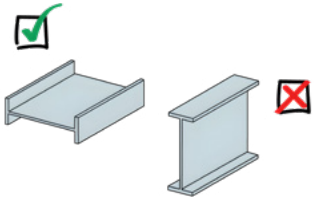

Figure 16. Store beams in horizontal position.

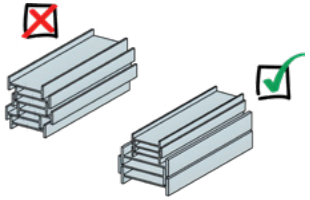

Figure 17. Stack widest beam at base.

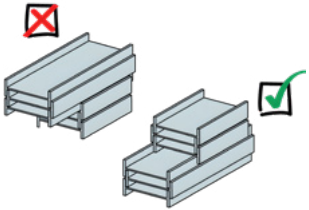

Figure 18. Stack longest section on the bottom and shortest on top.

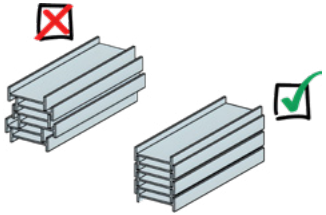

Figure 19. Align stack centrally.

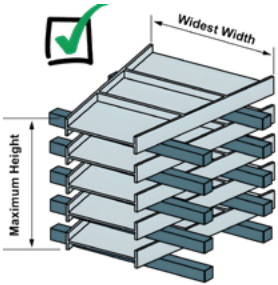

Figure 20. Dunnage alignment.

4 Prevention of storage-related corrosion

BlueScope recommends all steel product is stored in a fully enclosed, ventilated warehouse to reduce the risk of storage-related corrosion. It is important that coils, plate, sheet and long products are kept dry during storage prior to processing and installation. Packaging is only designed for weather resistance and protection during transit and should not be relied upon for preventing storage-related corrosion.

All steel products including hot rolled/uncoated, metallic-coated and pre-painted can be affected by moisture ingress. Rainwater and condensation are easily drawn between adjacent strip surfaces by capillary action or driven in by wind. Condensation can occur if the temperature of the metal is lower than the dew point of the surrounding air and moisture can be trapped between coil wraps, plates or sheets. In such cases the absence of freely circulating air may cause the visual appearance of the surface to be temporarily or permanently damaged. Additional precautions, such as increased packaging, should be taken near marine influence as chlorides will accelerate corrosion. Other precautions to reduce the risk of storage-related corrosion include stock rotation to use the older stock first and loading/unloading undercover to protect from rain.

If packs become wet, the sheets should be separated as soon as possible to enable drying by air circulation. If packs remain wet for extended periods of time, staining and/or corrosion may occur. Over longer time periods, severe corrosion, such as red rust and pitting can occur within packs.

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