## STANDARD WORK METHOD

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| CEMEX JUSTCi | **Standard Work Instruction Sheet** | | SWIS ID | SOP.0737.01.SHE.New Stockbay Walls Design |
| | | | RA ID | New Stockbays:- Design Approach |
| | Description: | **New Stockbays:- Design & Installation Procedure**<br>**(Various construction types)** | Date | 03.04.17 |
| FAMILIES | CUSTOMERS | EMPLOYEES | COMMUNITIES | SHAREHOLDERS |

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| Tools & Equipment required: | N/A |
| Comments: | |

| No | Full Task Description | Visual Reference |
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| 1 | **The following comments give guidance for the design, site positioning and installation of stockbay walls.**<br><br>Examples of bulk material retaining wall types are contained in items 2 – 8 inclusive.<br><br>Comments relating to the size and positioning of stockbays are contained in item 9.<br><br>Comments relating to the design approach are contained in item 10.<br><br>Comments relating to the installation and completion of works in conjunction with good driver practice are contained in items 11 & 12. | |

| No | Full Task Description | Visual Reference |
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| 2 | **Wall Type 1:-**<br><br>**Open Stockbays**<br>Wooden or concrete sleepers stacked laterally to form a vertical wall that locates in a series of equi-spaced rolled steel posts. The top of the posts finish approximately level with the top sleeper leaving all stocked material fully open to the weather. This type of wall is in common use throughout Cemex plants. Photo examples 001 – 004 inclusive.<br><br>**Covered Stockbays**<br>Very similar in design to the above open stockbays other than the rolled steel posts continue past the top sleeper in order to provide support to profiled steel clad walls and an overhead profiled steel clad roof. The stocked material is therefore partially protected from the weather. Photo examples 005 & 006.<br><br>**Overhead Conveyor Discharge Stockbays**<br>Some storage assemblies also have overhead tripper car conveying systems and associated maintenance walkways in order to feed material directly into the individual bays. Photo examples 007 & 008.<br><br>**Washing & Screening Plant Stockbays**<br>Additionally material can also be discharged and stored under washing and screening plant assemblies using similar wall constructions. Photo example 009. | Photo 001 Wooden Sleepers Example – Wall Type 1<br>  <br><br>Photo 002 Wooden Sleepers Example – Wall Type 1<br>  <br> |

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| **2 Cont'd** | | Photo 003 Concrete Sleepers Example – Wall Type 1<br>  <br>Photo 004 Concrete Sleepers Example – Wall Type 1<br>  |

| No | Full Task Description | Visual Reference |
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| **2 Cont'd** | | Photo 005 Covered Stockbay Example – Wall Type 1<br>  <br>Photo 006 Covered Stockbay Example – Wall Type 1<br>  |

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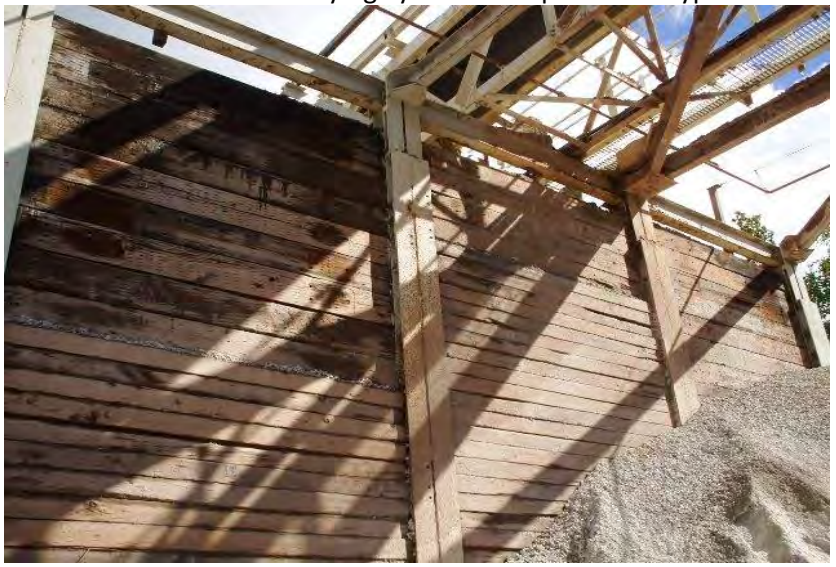
| **2 Cont'd** | | Photo 007 Overhead Conveying System Example – Wall Type 1<br>  <br>Photo 008 Overhead Conveying System Example – Wall Type 1<br>  |

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| **2 Cont'd** | | Photo 009 Washing & Screening Plant Discharge Bays Example – Wall Type 1<br>  |
| **3** | **Wall Type 2:-**<br><br>Precast and prestressed concrete A frame units (also called Alfablocs) are positioned in a straight line and are either freestanding or can be anchored to a concrete foundation (for higher loading applications) and are mechanically fixed to each other. They range in height from 1.22m – 6m. Photo example 010. | Photo 010 A Frame Example – Wall Type 2<br>  |

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| 4 | **Wall Type 3:-**<br><br>Precast concrete L frame units (also called L blocs) are positioned in a straight line and are always anchored to a concrete foundation. Some manufacturers tie each unit together via a tongue and groove joint arrangement whilst others leave them fully independent. Some manufacturers also offer prestressed units whilst others don't. They range in height from 3.6m (standard) – 5m. Photo examples 011 & 012. | Photo 011 L Frame Example – Wall Type 3<br>  <br>Photo 012 L Frame Example – Wall Type 3<br>  |

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| 5 | **Wall Type 4:-**<br><br>Precast concrete taperbloc units are positioned in a straight line, the older generation are lighter and therefore require anchor bolting to a concrete foundation whilst the newer taperbloc XL range is a heavier construction and is designed to be freestanding. They range in height from 2.4m – 3.0m. Photo example 013. | Photo 013 Taperbloc Example – Wall Type 4<br>  <br>The older lighter units are identified by a hollow triangular base (as shown arrowed) whilst the newer XL range has solid bases |
| 6 | **Wall Type 5:-**<br><br>Precast mass concrete rectangular blocks that interlock via raised male connectors and are built in a straight line in a standard staggered joint brick formation. These are commonly called Lego blocks (also called Legato, Duo, Betablocs) and maintain their stability and rigidity without the need for any additional mechanical fixings.<br>The blocks are available in various sizes, the larger blocks measure 800mm width x 800mm depth x 1600mm length complete with up to 10 male connectors and weigh approx 2.4Te whilst the smaller blocks measure in the region of 600mm width x 450mm depth x 1500mm length and weigh approx 1.0Te although the dimensions are subject to slight variation depending on the individual suppliers.<br>The walls generally range in height up to approx 2.4m although utilising spreader footblocks can increase the height beyond this up to approx3.2m. Photo example 014 (shows larger size blocks).<br>Additional strength can also be achieved by having a double width wall (i.e, laying blocks side by side). | Photo 014 Lego Block Example – Wall Type 5<br>  |

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| 7 | **Wall Type 6:-**<br><br>Precast and prestressed modular interlock panels that are mechanically fixed to the inside faces of building columns to form perimeter walls. The panels are self supporting and sit on the concrete ground slab. The lateral joints are usually tied together by a tongue and groove arrangement. Photo examples 015 & 016. | Photo 015 Precast Modular Panels Example – Wall Type 7<br>  <br>Photo 016 – Precast Modular Panels Example – Wall Type 7<br>  |

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| **8** | **Wall Type7:-**<br><br>Cast in-situ concrete walls and precast concrete wall panels that are of a fixed base design and are tied into the civil foundation design of a building are not normally subject to potential instability. Photo examples 017 & 018. | Photo 017 – Cast In-situ Example – Wall Type 7<br>  <br>Photo 018 Cast in-situ Retaining Wall Example – Wall Type 7<br>  |

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| 9 | **Stockbay Sizes & Positioning**<br><br>An initial point worthy of note relates to the possibility of partial failure of a stockbay retaining wall, namely:-<br><br>If a retaining wall that has been correctly installed and maintained receives a sufficiently high impact load from a moving plant vehicle it will not be able to fully absorb the energy and it will suffer a level of damage such that a section of it can potentially collapse. Part of a wall in conjunction with any localized stored material can therefore fall externally to ground. Of course, this is an exceptional case and a vehicle would have to be driven in an unacceptable manner for this to occur. The point has been raised to highlight the importance to the adherence of correct driving techniques during filling and emptying operations in conjunction with avoiding excessive overfilling of material in order to prevent this type of failure.<br><br>The point has also been raised to indicate that due consideration must be given to where stockbay walls are positioned on site. If the walls can be sited away from any areas where personnel may walk (i.e, designated pedestrian traffic walkways) or from any plant buildings or from proximity to a site boundary, then any partial wall failure would offer a low risk of injury to personnel or of damage to any adjacent plant equipment.<br><br>As overspill will also periodically occur, this again reduces the risk of injury. Clear access round the stockbay perimeter walls also enables any escaped material to be readily cleared up.<br><br>Consideration should also be given to fitting warning signs attached to the stockbay walls giving guidance to the shovel drivers not to push against the walls and to keep a prescribed distance away from the base of the walls. Photo example 019.<br><br>Where space is not at a premium, consideration can be given to building an earth bund wall at the rear of the bays. This offers protection against rear wall failure should any plant vehicle exert excessive pressure during bucket filling. A pedestrian exclusion zone could also be set up, if preferred. | Photo 019 Driver Information Sign<br>  |

| No | Full Task Description | Visual Reference |
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| **9 Cont'd** | Bay size also requires consideration. If a specific volume of material requires storage then a larger bay will only require lower retaining walls as opposed to a smaller bay requiring higher walls. The lateral side pressures generated by stored material that are exerted on a retaining wall, increase with the height of the wall. Partial failure of a low height wall will offer less risk of injury to personnel or damage to plant.<br><br>A further additional point for quayside consideration:- It is to be noted that there has been occasion on some wharf areas where tidal water has found routes past the wharf wall and under the site frontage, which has lead to the washout of material leaving voids under the apron slab. Stored loads adjacent to the quayside substantially increase the ground bearing pressure. It has been known for an apron slab to settle under the increased pressure and for the wharf wall to partially cant over. Positioning any storage areas several metres inboard is therefore worthy of thought. | |
| **10** | **Design Approach**<br><br>Once the position and height of the new walls has been determined, potential suppliers will request the characteristics of the bulk materials to be stored (bulk density, approx angle of repose, cohesion classification etc).<br><br>The precast concrete wall suppliers will provide the necessary design calculations inclusive of the maximum permissible wall impact loads (expected loads imposed on the wall by loading shovels etc during normal procedures of loading and unloading) and the required ground bearing pressure. If a supplier is unable to offer this service then an independent qualified engineer must be utilised.<br><br>The steel posts / sleeper infill type walls are often supplied and installed by the main contractor in charge of a full plant installation. The stockbay walls can on occasion become a minor addition to the main core of the work.<br><br>A design analysis for this type of wall construction must also be undertaken and not inadvertently overlooked. Installation of retaining walls without initially carrying out a steelwork / foundation design analysis is unacceptable. | |

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| **10 Cont'd** | With regard to the steel posts / sleeper infill walls:- Design calculations by a qualified engineer will be required to be retained on record that give clear indication that the section sizes of the posts (UC's, UC's or PFC's) and the foundation anchorage are acceptable for the forces and pressures generated by the stored material. The calculations will therefore also be inclusive of the civils design. This is necessary to ensure the posts cannot suffer from excessive stress or undue rotation at their bases.<br><br>An assessment of the ground bearing pressure local to the wall positions will initially be required in order to enable the concrete foundation to be suitably designed (i.e, to ensure the ground bearing and stability requirements are met).<br><br>As stored materials may well change over the years, it is recommended that all walls are designed to withstand the highest density material intended for use.<br>This will enable a supplier to determine an appropriate wall type and to supply design calculations to support this. All fixing bolt details provided by the supplier must be adhered too. If an incorrect type of foundation anchor bolt is fitted it can lead to wall failure at a later date. The specified bolt size, grade, type (i.e, resin anchor), embedment depth and coating finish must therefore be used and the supplier installation procedure must be followed.<br><br>Only Approved Suppliers must be contacted. In instances where concrete blocks are being proposed some suppliers could potentially offer substandard blocks that can suffer spalling and general deterioration from freeze / thaw rainwater action. This will be avoided by using Approved Suppliers. They will also be able to offer a suitable design life (i.e, Elite Precast Products offer a 100 year design life).<br><br>The suppliers must also confirm an acceptable surcharge limit in order to ensure all sites are clear on safe operational usage. It is to be noted that whilst most types of retaining walls can be designed to allow for the stored material angle of repose (surcharge), the precast concrete lego block walls are usually only suitable for flat fill. Again, warning signs can be fitted to any stock bay perimeter walls that have only been designed to accept flat fill. | |

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| 11 | **Installation & Completion of Works**<br><br>The wall components are generally purchased as supply only. The main contractor or the groundwork contractor will usually carry out the installation work. It is therefore important that the contractor is in receipt of all supplier technical information giving full details of the correct method of installation.<br><br>In particular, a number of types of precast concrete A frame, L frame and taperbloc units are designed to work in a composite manner. It s therefore imperative that the vertical cover straps that tie adjacent units together in conjunction with the correct holding down bolts are installed in full accordance with the supplier instructions.<br><br>The Cemex Project Manager must carry out a visual inspection on full completion and can contact the supplier or Cemex Engineering Services for assistance, if deemed necessary. | |
| 12 | **Good practice during filling and emptying of stockbays**<br><br>Overfilling is to be avoided as this increases the lateral pressure on a retaining wall that could be in excess of its design capability.<br><br>Wall impact from a loading shovel bucket should also be kept to a minimum. The bucket should not be rammed up against a wall. Driver training is therefore essential to ensure material is filled and removed in the correct manner.<br><br>As previously mentioned, consideration can also be given to fitting warning signs attached to the stockbay walls giving guidance to the shovel drivers not to push against the walls and to keep a prescribed distance away from the base of the walls. | |