Analysis of Critical Success Factors in Implementation of Dry Wall Technique in Construction Industry

Pranoti Chandrakant Jagtap[1], Abhijit N. Bhirud[2]
Department of Civil Engineering
[1] Baramati Pune India
[2] ICOER Pune India

Abstract- *In construction industry, time, cost & quality are the critical factors to be controlled for the success of a project. A change can be brought by using innovative technique like drywall.*

Gypsum products have been used over centuries in the construction space and are the material of choice because of gypsum's unique properties. A gypsum board panel consists of a layer of gypsum plaster sandwiched between two layers of paper.The board is then formed by sandwiching a core of the wet mixture between two sheets of heavy paper or fiberglass mats. When the core sets it is then dried in a large drying chamber, and the sandwich becomes rigid and strong enough for use as a building material.

Gypsum is used as plasterboard to create false ceilings and high performance drywalls and partitions. Plasterboard is one of the earliest and most versatile prefabricated construction materials that continue to outstrip construction growth in most countries Gypsum plasterboard systems are very fast to erect and provide huge labour saving and flexibility in construction. Globally, gypsum drywall systems are used as a replacement of brick and mortar construction.

By using qualitative research methodology & by studying on the project VOYAGE to the stars by cloud9 of acropolis Purple developers luxury residential project located in Sr no 43/44, NIBM Road, Pune 411060, India Website: wwwcloud9estate.in as my case syudy I had collected the required data.

This assumes significance in high-rise structures, resulting in not only structural cost saving, but a reduction in the burden of moving up material. Studies have shown that drywall leads to structural cost saving of as much as 15%. Drywall is made of gypsum plasterboard, which is 100% recyclable hence gives green construction. Drywalls are also water free, thus saving precious natural resources. Plasterboard Steel Stud Partition Systems are designed for use in both non fire-rated and fire-rated applications. Plasterboard Steel Stud Partition Systems consist of single or multiple layers of Plasterboard sheets, screw fixed to steel framing with corrosion resistant, bugle head screws.

The non fire rated partitions detailed in this project information are suitable for standard partitioning construction in a range of new construction areas. They are also applicable in the renovation of all types of buildings. These speedily installed partitions provide smooth, durable, non-combustible, low cost, light weight systems that can also achieve acoustic performance ratings

I. INTRODUCTION

Construction materials have been subjected to research & development over the past century. In Construction Industry, Time, Cost & Quality are the three Critical factors to be controlled. Gypsum products have been used over centuries in the construction materials and are the material of choice because of gypsum's unique & environmental friendly properties. Gypsum is used as gypsum board to create false ceilings, drywalls and partitions. Gypsum board is one of the earliest and most versatile prefabricated construction materials that continue to outstrip construction growth in most of countries gypsum board systems are very fast to erect and provide huge labour cost saving and flexibility in construction. Gypsum drywall systems are used for replacement of brick/block and mortar construction. In the developed world, the building solutions are adequately advanced from a performance point of view as the construction methods have evolved over a period of time. In India the construction practices are evolving and hence the use of advanced building systems focused on performances like fire, acoustics etc. is not very wide spread as yet.

A wallboard panel consists of a layer of gypsum plaster sandwiched between two layers of paper. The raw gypsum, $CaSO4•2\ H2O$, is heated to drive off the water then slightly re-hydrated to produce the hemihydrate of calcium sulfate ($CaSO4•½\ H2O$). The plaster is mixed with fiber (typically paper and/or fiberglass), plasticizer, foaming agent, finely ground gypsum crystal as an accelerator, EDTA, starch or other chelate as a retarder, various additives that may decrease mildew and increase fire resistance (fiberglass or vermiculite) of final product, wax emulsion or silanes for

lower water absorption. The board is formed by sandwiching a core of the wet mixture between two sheets of papers or fiberglass mats. When the core sets it is then dried in a large drying chamber, and the sandwich becomes rigid and strong enough for use as a building material.

This project gives details of approved methods of fixing and jointing gypsum board Standard Core and Wet Area Gypsum board in non-load-bearing non fire-rated steel stud partition systems gypsum board. Steel Stud Partition Systems consist of single or multiple layers of gypsum board sheets, screw fixed to steel framing with corrosion resistant, bugle head screws according to the acoustic requirement of structure. The non fire rated partitions detailed in this project information are suitable for standard partitioning construction system in a range of new construction areas. They are also suitable for application in the renovation of all types of buildings. These speedily installed partitions provide smooth, durable, non-combustible, low cost, light weight systems that can also achieve acoustic performance ratings with variety of boards available in market. Gypsum board is manufactured to the requirements of Australian Standard AS/NZS 2588:1998 - "Gypsum board". It is to be installed in accordance with the requirements of Australian Standard AS/NZS 2589.1:1997 - "Gypsum linings in residential and light commercial construction application and finishing Part 1: Gypsum board"

1.1 Objectives:

- To give faster construction.
- To reduce dead load of structure.
- To demonstrate use of recyclable material.
- To provide smooth finishing.
- To reduce cost of structure.

1.2 Future scope

- Introduction to green construction materials in construction.
- Comparison of drywall to the traditional methods(brick/block).
- Analysis of amount of time & cost saved by use of drywall technique.
- Analysis of risk factors in execution of drywall.
- Preparation of checklists onsite for drywall technique.

II. LITERATURE REVIEW & PROBLEM STATEMENT

Paper 1

ESTIMATE THE COST OF Installing & Finishing Drywall with Special Consideration Above 10' in Height submitted by Erich Seber, CPE

Erich Seber, CPE is the President of White Birch Enterprise LLC, a consulting company providing preconstruction services to owners and A/E firms serving primarily the Northeast. Seber holds a B.Eng. from Stevens Institute of Technology and a MBA from Bryant College. Throughout his thirty year career he has held positions from Project Manager to COO of firms listed in the ENR top 400. He has gained a diversified perspective by working for developers and a Fortune 500 aircraft manufacturer. His primary areas of expertise are design/build in the commercial sector and low income multifamily construction projects.

The purpose of this paper is to guide the estimator in doing a proper takeoff and estimate of both the installation and finishing of drywall (gypsum board). Gypsum board is the more technically accurate terminology but this paper will also use the more common term "drywall" Interchangeably throughout this paper. This paper will strongly emphasize an accurate takeoff as the foundation to a predictable pricing effort. This paper uses the term "finishing" to represent the preparation of the gypsum board for the next application. The typical "finishing" operation is paper tape set in joint compound bedding followed by two coats of joint compound, followed by sanding to provide a smooth paintable surface

Paper 2

Literature review and analysis of injury data associated with the use of plasterers' Stil ts during the finishing of plasterboard in domestic construction : Research report 2009

Work Cover Assist Applied Research Project Final Report - 'Literature review and analysis of injury data associated with the use of plasterers' stilts during the finishing of plasterboard in domestic construction'. This research was funded under the Work Cover Assist Applied Research Program. The grantee, the Association of Wall and Ceiling Industries (AWCI) undertook the research in partnership with VIOSH Australia, University of Ballarat. The conclusions in the final report are those of the authors and any views expressed are not necessarily those of Work Cover NSW. The purpose of the research was to undertake a comprehensive review of previous research relating to plasterers' work

platform use and analysis of workers compensation data for injuries relating to work platform use by plasterers. A review of the literature was undertaken to identify the research and other related reports that may contribute to an understanding of the musculoskeletal and falls risks to plasterers undertaking finishing and cornice hanging tasks while using stilts, trestles or alternative equivalent working platforms. The research found that there is very limited information in the literature that specifically addresses the risks associated with plasterers' work platforms. The analysis of workers compensation data showed that plasterers suffered a significant number of compensable falls injuries and injuries associated with stepping off work platforms.

A review of the literature was undertaken to identify the research and other related reports that may contribute to an understanding of the musculo-skeletal and falls risks to plasterers undertaking finishing and cornice hanging tasks while using stilts, trestles or alternative equivalent working platforms. It was found that there is very limited information in the literature that specifically addresses the risks associated with plasterers' work platforms. However, there is general agreement that plasterers are over represented in the injury claims databases and many of the injuries are indeed associated with falls and over-exertion. The few reports that do specifically address work platforms suggest that ladders and scaffolding are implicated in many injuries.

Paper 3

An investigation into the use of plasterboard manual handling aids in the GB construction industry and factors helping an hindering the practicability of their application: Prepared by Tony Wynn the Health and Safety Laboratory for the Health and Safety Executive 2010

There is clear potential for risk of musculoskeletal injury when lifting and handling panel products such as plasterboard; and dry-lining operatives have been shown to have one of the highest prevalence rates for musculoskeletal disorders (MSD) in the construction industry. These problems are common because many of the materials they handle are heavy, and require the adoption of awkward postures (i.e bending and twisting) when lifting. The introduction of ergonomic improvements may reduce physical load and the incidence of sickness absence. However, despite the existence of mechanical lifting devices for handling and assisting with the installation of plasterboard, there is reservation within the industry as to how practicable such solutions are in terms of their 'real world' application. The purpose of this report is to investigate the manual handling and work related risk factors for MSD associated with the installation of plasterboard, and to evaluate the impact of manual handling aids in terms of risk reduction and the time taken to install plasterboard. This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

Manual handling of plasterboards in order to construct interior building walls and ceilings is a risk factor for musculoskeletal complaints (van der Molen et al., 2007) and plasterers have been shown to have one of the highest prevalence rates for musculoskeletal disorders (MSD) in the construction industry (Reid et al., 2001). MSD are caused by many factors, including awkward postures (e.g. bending, stretching, twisting), repetitive movements, using force and manual handling (lifting and carrying) and these activities are recognized as a regular component of plasterers' work (Chiou et al., 1997; Lipscomb et al., 1997; Pan and Chiou, 1999; Smallwood et al., 2006). They can occur in any part of the body, but are particularly common in the lower back, neck, shoulders, elbows, wrists and hands. Furthermore, repeated bending or standing for long periods, particularly on uneven surfaces, can lead to discomfort in the legs, knees and feet (van der Molen et al., 2007). These problems are common in plasterers because, many of the materials they handle are quit heavy, and require bending and twisting when lifting and fitting panels (Cowley and Leggett, 2003; Reid et al., 2001)..

Paper 4

Seismic Performance of Gypsum Walls – Experimental Test Program

Kurt M. McMullin San Jose State University San Jose, California & Dan Merrick San Jose State University San Jose, California July 1, 2001

Seventeen experimental tests were conducted to meet the required research objectives of determining the cost-damage relationship and engineering characteristics of residential gypsum wallboard partition walls. Specimens were 8-foot high and 16-foot long, double-sided with ½" gypsum wallboard. Test variables included: fastener type and spacing, loading protocol, top-of-wall boundary condition, and method of attaching the wallboard to the top sill, wall opening layout, and innovative construction methods, influence of door and floor trim, and repair strategies. Instrumentation measured applied load, lateral deflection at the top of the wall, lateral deflection at the bottom of the wall, shear distortion of the piers, and uplift at the door trimmers. Findings include a distinct change in strength for walls built with various fastener types and wall penetration layouts. Damage patterns begin with the initiation of cracks at the wall penetrations and

cracking of the paint over a few fastener heads, usually initiating at drift levels near 0.25%. Maximum loads are sustained at drifts of approximately 1 to 1.5%. At this point, one of two failure modes initiates.

Cost-damage relationships appear to be similar to a step-function. The cost of repair seems closely related to the number of tradesmen required for repair work. While a single multi-skilled contractor can repair minor cracking, larger levels of damage may require demolition crews, drywall crews, carpenters and paint crews. Total loss of economic value of the wall appears to occur at drifts of approximately two percent.

III. THEORETICAL ASPECTS

Drywall is a high performance light weight partition system consisting of GI steel frame, encased with gypsum plasterboards on either side attached through self-drilling drywall screws.Drywall is the principal wall material used in the United States for interior purposes. It is made of a sheet of gypsum covered on both sides with a paper facing and a paperboard backing. Drywall is also referred to as gypsum board, wallboard, plasterboard, gypsum board and sheet rock. Gypsum is calcium sulfate dehydrate ($CaSO4•2H2O$), a naturally occurring mineral that is mined from dried ancient sea beds.

Gypsum board is the generic name for a family of panel products that consist of a noncombustible core, composed primarily of gypsum, and a paper surfacing on the face, back and long edges. Gypsum board is one of several building materials covered by the umbrella term "gypsum panel products." All gypsum panel products contain gypsum cores; however, they can be faced with a variety of different materials, including paper and fiberglass mats.

Gypsum board is often called drywall, wallboard, or gypsum board. It differs from other panel-type building products, such as plywood, hardboard, and fiberboard, because of its noncombustible core and paper facers. When joints and fastener heads are covered with a joint compound system, gypsum wall board creates a continuous surface suitable for most types of interior decoration. As an alternative to a week-long plaster application, an entire house can be dry walled in one or two days by two experienced drywallers, and drywall is easy enough to use that it can be installed by many amateur home carpenters. In large-scale commercial construction, the work of installing and finishing drywall is often split between the drywall mechanics, or hangers, who install the wallboard, and the tapers and mud men, or float crew, who finish the joints and cover the nail heads with drywall compound. Dry wall can be either finished level 4 or in high end applications can be treated with a level 5 finish. Depending on how significant the finish is to the customer the extra step in the finish may or may not be necessary. Drywall is cut to size, using a large T-square, by scoring the paper on the finished side (usually white) with a specific utility knife, breaking the sheet along the cut, and cutting the paper backing. Small features such as holes for outlets and light switches are usually cut using a keyhole saw or a small high-speed bit in a rotary tool. Drywall is then fixed to the wall structure with nails, glue, or more commonly in recent years, the now-ubiquitous drywall screws.

Drywall screws are designed to be self-tapping. Drywall screws heads have a curved taper, which allows them to self-pilot and install rapidly without having to be punched through the paper cover. When finished driving, these screws are recessed slightly into the drywall. Screws for light-gauge steel framing have an acute point and finely spaced threads. If the steel framing is heavier than 20-gauge, self-tapping screws with finely spaced threads must be used. In some applications, the drywall may be attached to the wall with adhesives. Electric screw gun used to drive drywall screws. After the sheets are secured to the wall studs or ceiling joists, the installer conceals the seams between drywall sheets with joint tape and several layers of joint compound (sometimes called mud). This compound is also applied to any screw holes or defects. The compound is allowed to air dry then typically sanded smooth before painting. Alternatively, for a better finish, the entire wall may be given a skim coat, a thin layer (about 1 mm or 1/16 inch) of finishing compound, to minimize the visual differences between the paper and mudded areas after painting.

Another similar skim coating is always done in a process called veneer plastering, although it is done slightly thicker (about 2 mm or 1/8 inch). Veneering uses a slightly different specialized setting compound ("finish plaster") that contains gypsum and lime putty. This application uses blue board, which has special treated paper to accelerate the setting of the gypsum plaster component. This setting has far less shrinkage than the air-dry compounds normally used in drywall, so it only requires one coat. Blue board also has square edges rather than the tapered-edge drywall boards. The tapered drywall boards are used to countersink the tape in taped jointing whereas the tape in veneer plastering is buried beneath a level surface. One coat veneer plaster over dry board is an intermediate style step between full multi-coat "wet" plaster and the limited joint-treatment-only given "dry" wall

3.1 Materials:-

Steel stud (CS)

• 51, 64, 76, 92 and 150mm wide in various gauges

Top and bottom track (CT)

• 51, 64, 76, 92 and 150mm wide in various gauges. Track is supplied in 3000mm lengths, in width to suit the wall studs.

Deflection head top track (DT)

• 64, 76, 92 and 150mm wide in various gauges. Deflection Head Top Track is supplied in 3000mm lengths. Legs are extended to 50mm to accommodate anticipated slab deflection.

Gypsum Plasterboard sheets

• 10mm and 13mm

Wet Area Plasterboard All boards with recessed edge, 1200mm or 1350mm widths, lengths as required.

Joint treatment compound

jointing compound is used to fill joints.

Fastener

Plasterboard Screws:-
- 25mm, 45mm, 50mm or 57mm
-Bugle Head Drill Point Screws 6g or 8g x 25mm or 45mm
-Drill Point Wafer Head Screws 8g x 12mm, 8g x 16mm or 10g x 16mm
-Gypsum Laminating Screws 6g or 10g x 32mm, 40mm or 50mm
• Rivets: • 3mm x 6mm all steel

Metal trim

• Long Leg Stopping Angle
• Shadow line Stopping Angle

Corner bead

• Metal External Corner Bead

Control joint

• Control Joint Component

3.2 Characteristics:

Non combustible

These systems are "noncombustible". They may be used where the Building Code of Australia calls for non-combustible linings.

Lightweight

These lightweight, slim partitions offer significant reduction in dead loads of structure and save floor area.

Economical

Low material costs, dry construction and speed of installation enable realistic and competitive construction costs to be achieved.

Sound isolation

Ratings from STC30 to STC60, as achieved in acoustic tests, are available. Comparable field performance depends on building design and careful attention to detailing and workmanship. It is important that the full perimeter of the partition be sealed with an approved flexible acoustic sealant, as well as all penetrations.

Deflection head design

Floor slab deflection can cause damage to partitions. The partition head relief detail covered in this manual is for maximum deflection of 16mm.

Limitations

- Non load-bearing.
- These systems should not be used where conditions of constant excessive moisture or humidity are prevalent, i.e. more than 90% relative humidity.
- Maximum stud spacing is 600mm.
- Components must not be used if fractured or damaged.
- Control joints should be provided in long continuous runs of partition at 12 meter centres maximum, wherever structural expansion joints are located, and at every change of material mandatorily.

Limiting heights

Limiting structural heights requirements have been obtained by computation and from extensive mechanical testing of material.

Photo no 1: storing of gypsum boards

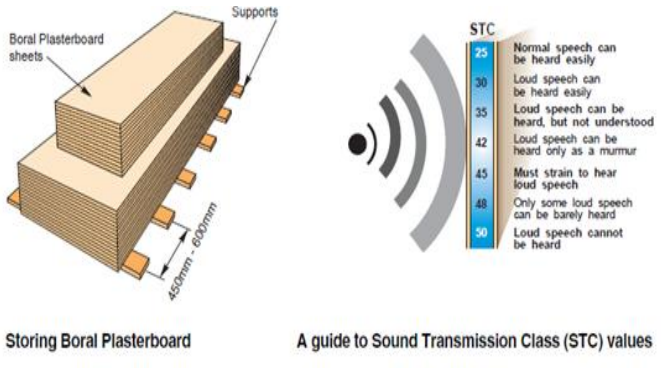


Fig no 1: storing of plasterboard

IV. RESEARCH METHODOLOGY

- Visiting sites for Collection of data.
- In completing this study, there are two methods will be used to obtain data namely:
- **Primary data:** were collected through completed projects, personal interview especially Project Manager and Planner Engineer in order to understand the current practice on implementation Microsoft Project in term of Planning and Scheduling of activities.
- **Secondary data:** were obtained from external sources such as books, journals, internet and magazines. The collection of literature review will be based on the current scenario on of the construction industry today. Having the data collection on hand, it will then be analyzed and results of the analysis will be based on the data collected through various channel. The final level will see the conclusions and recommendation by the author in enhancing the eligibility of the data collected.
- Comparative study regarding time and cost with traditional methods.
- Suggesting safety precautions and checklists during actual execution.

V. INSTALLATION PROCEDURE

5.1 Installation

a. Laying out

Partition layouts should be marked accurately. Always check individual measurements against overall site dimensions as per actual. Align the top and bottom tracks of the partition accurately according to the plan layout with accuracy of dimensions. Attach at ceiling and floor to structural elements carefully. Use suitable fasteners for anchoring the partition wall to the floor or ceiling at base and top head for fixing. Locate fasteners at 50mm or as per requirement from each end. Space provided is at maximum 600mm centres along each track.

Photo no 2: layout

b. Framing installation

Cut partitioning studs 16mm short of the floor to ceiling height to allow a 16mm expansion gap at top for variations. Allowance should be made for possible deflection of floor structure over walls due to variations. Studs in partitions are not to be fastened to top and bottom tracks except boxed studs facing door openings as required, in which case the boxed studs are pop riveted to the tracks.

Photo no 3: Framing installation

c. Application of Gypsum Plasterboard

Plasterboard sheets are usually installed vertically or horizontally as per design given on single layer partitions Where a second layer is required on one or both sides, plasterboard can be installed vertically or horizontally in accordance with the details. Where specified, insulation is installed prior to application of the second side sheets.

Photo no 4: horizontal & vertical joints

d. Fixing Method - Single layer application

Providing no deflection requirement exists, cut Plasterboard to provide full length floor-to-ceiling sheets, allowing for 10mm maximum gap at floor and ceiling.

e. Screw fixing method

First side - Screw-fasten Plasterboard vertically to studs at edges and on intermediate studs, centering, abutting edges on stud flanges. Sheets should be installed by advancing in the direction of the stud web. Where one layer only is to be applied to each side, screws should be minimum 25mm long. Space is provided at 200mm centres on sheet edges and at 300mm centres on intermediate studs. Fasten screws approximately 10-16mm from sheet edges.

Second side - Cut the first sheet of Plasterboard 600mm wide. This creates a stagger with the joints of the sheets applied on the opposite side of the partition. Screw fastens this sheet and all subsequent full-width sheets to studs. Screws should be 25mm long. Space given is at 200mm centres on edges and at 300mm centres on intermediate studs. Return to first side and screw fasten Plasterboard sheets to previously unattached studs.

Fixing Method - Multiple layer application

Normally, non fire-rated steel stud partitions consist of a single layer of Plasterboard each side. However, where acoustic requirements dictate, multiple layers are to be installed as outlined below:-

Vertical application

Screw fasten additional layers of Plasterboard in the same sequence as for the first layer, except that all joints are staggered a minimum of 200mm with the previous layer to prevent vertical joints coinciding. Screws on first layer of multiple layered partition walls are spaced at 400mm centres minimum throughout. Screw fasten second layer with minimum 45mm long screws at 200mm minimum centres on sheet edges and at 300mm minimum centres on intermediate studs.

Horizontal application

Screw fasten additional Plasterboard horizontally to all studs, centering the end to end joints on stud flanges. Stagger the face layer butt joints of upper and lower sheets by 600mm from each other, and by 600mm from the vertical joints of the first layer. Fasten the longitudinal edges to inner

layer of Plasterboard between studs with laminating screws at 200mm centres maximum.

Fastener spacing

Fasten Plasterboard to stud flanges with 25mm or 32mm screws for first layer, 45mm screws for second layer and 60mm screws for third layer applications.

Face sheet only:- Space screws at 200mm centres at vertically abutting edges or ends, staggering screws in adjacent boards 100mm. Locate screws no closer than 10mm or more than 16mm from board edges and ends. Space screws at 300mm centres around openings and on intermediate studs in the field of the plasterboard. Screw spacing on inner sheets need only be 400mm maximum centres on joints and intermediate studs.

Jointing

Finish all joints and internal angles with the appropriate Plasterboard jointing system comprising perforated paper tape and jointing compound. Stop exposed fasteners on face layers and finish external corner beads and stopping angles as required with at least two coats of approved jointing compound. Feather out from nose of bead to plaster board face.

Caulking

Caulk all perimeter gaps in acoustic rated walls with Plasterboard Cornice Adhesive (or other approved sealant) as shown in construction details.

Skirting

Screw fix skirting's to bottom tracks or adhere to the plasterboard as required.

Photo no 5: skirting provision

Decorating

Apply paint or other decorative finishes required according to the manufacturers' instructions. Decoration work should not be commenced until all plasterboard surfaces and joints are dry.

Boxed studs

Studs may be boxed together to provide greater frame strength. Studs are usually boxed at frame door and other openings and as a means of supporting heavy fixtures to the partition. When used at frame openings, secure both flanges of boxed studs to the tracks with pop rivets.

Noggings and trimmers

Noggings are required as headers above doorways and borrowed light frames, for reinforcement behind fixture attachments, and where special circumstances require additional stiffening of the frame. Noggings are formed from lengths of steel track, approximately 100mm longer than the stud spacing. Cut notches into track base to fit between the studs. Position and fasten with stud crimper, or with pop rivets as required.

Adhesive and screw fixing method

Stud adhesive must be used in conjunction with screws and must not constitute a fixing system on its own. Do not use adhesive fixing method for multiple layer applications.

Applying adhesive

All surfaces to receive adhesive should be dry and free of dust, grease, oil or other foreign materials. To facilitate flow, the temperature of adhesive should not be less than 4oC.

- Apply stud adhesive to framing members with a broad knife, forming "walnuts" of adhesive 25mm in diameter by 15mm high, commencing at a minimum of 200mm from the sheet edges
- Position the adhesive at 200 to 230mm centers and at least 200mm from screwing points.
- Adhesive must not be placed where screws will be driven (except for temporary fasteners).
- Do not place adhesive on parts of framing members in contact with the perimeter of the sheet.
- Do not permanently screw through adhesive.

Note:-

Plasterboard Stud Adhesives are not approved for use in fire-rated and wet-area systems.

f. Applying Plasterboard with screws & adhesive

Fix Plasterboard sheets within 30 minutes of applying adhesive (to avoid skin forming on adhesive).

- Screw-fix Boral Plasterboard at internal and external angles, sheet ends and edges at 200mm maximum vertical centre to centre (refer page 12 of this Manual – horizontal fixing detail). Screw at 300mm maximum centres around openings.
- Hold sheet against framing members for a minimum of 24 hours with sufficient temporary fasteners (screws through small plasterboard blocks)
- When adhesive has cured, remove temporary fasteners.

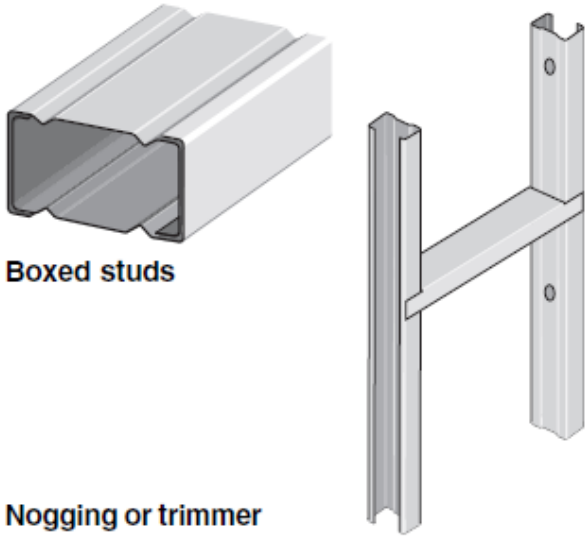


Fig no 2: studs

g. Stud gauges

Metal studs are available in several different Base Metal Thicknesses (BMT) Steel Stud Partition Systems use the Rondo 0.50mm BMT, 0.55mm BMT, 0.76mm BMT and 1.15mm BMT studs. The use of thinner gauge studs is not recommended, as excessive twisting and flexing is liable to occur when the plasterboard sheets are being fastened. As a consequence, an uneven finish (lipping) of adjacent plasterboard sheets is likely to occur.

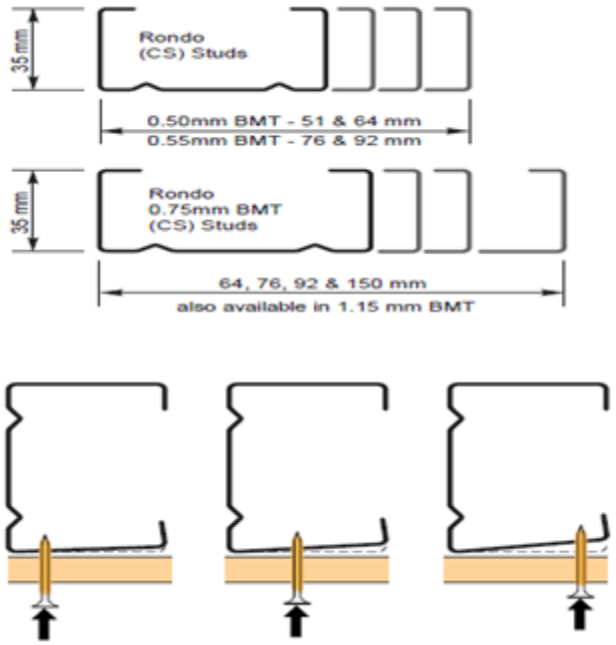


Fig no 3 : stud gauge

Fastening

Unlike rigid timber framing, light gauge steel framing is prone to flexing and twisting when driving fasteners to secure plasterboard sheets. As illustrated in figure 1, the further away from the web (back) of the steel stud that a fastener is driven, the more the stud will deflect. Unless the correct method of fixing is used, this deflection may cause unacceptable lipping of the joints.

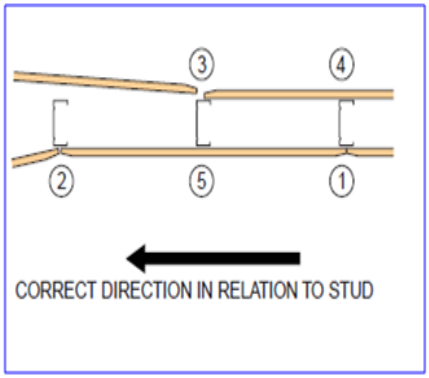
Fasteners

Plasterboard sheets are fastened to steel studs using Drill Point or Needle Point screws. However, fastening plasterboard to 0.75mm BMT and 1.15mm BMT studs is much easier if Drill Point screws are used. Drill Point screws require less effort, reducing the chance of stud distortion. Needle Point screws, although suitable for the lighter gauge 0.50mm BMT and 0.55mm BMT studs, are not recommended for use with the heavier gauges. The additional force needed increases the chance of twisting the stud or bending the flange.

Installation and fastening sequence

The first plasterboard sheet installed at a joint should be fixed to the open side of a stud flange. Additional sheets are then installed in the direction toward the closed side of the stud web. When installing the first side, screw-fasten the plasterboard sheets to studs at edges only, as illustrated in Figure 5 (positions 1 & 2). Then, on the second side, fasten the edge (position 3) followed by intermediate studs (position 4).

Return to the first side and fasten sheets to previously unattached studs (position 5).



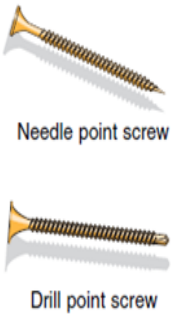


Fig no 4: Installation and fastening sequence

h. Correct installation

The **correct** direction of sheet installation is in the direction from the open side of the stud to the closed side of the stud web (Figure 6). The first sheet installed at a joint is screwed to the flange at the open side of the stud. The flange will initially deflect then straighten as the screw pulls tight. Ensure that the stud is adequately supported to avoid twisting, and fully screw this sheet to the stud before continuing. The next sheet is now screwed to the flange at the closed side of the stud. The deflection on this part of the flange is very small, and the previously installed sheet helps keep the assembly rigid during the installation of the second sheet. If fixed correctly the result is a flat joint with no lipping (Figure 7). The correct installation sequence is illustrated in Figure 5 below.

Do fix plasterboard sheets in the direction from the open side of the stud to the closed side of the stud (Figure 6).

Do screw the first sheet at a joint to the flange at the open side of a stud.

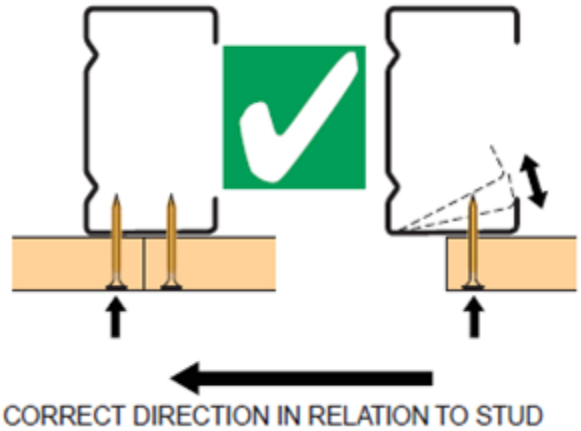


Fig no 5

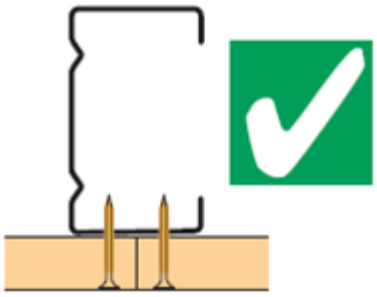


Fig no 6

5.2 System selector

System No.	Fire-Rating FRL (mins) (Test Ref.)	Description and Physical Data	Acoustic Performance
SS8	Non fire-rated partition	2 x 13mm Firestop / Width / 2 x 13mm Firestop Security Wall - Steel Stud - 2 layers 16mm Boral Plasterboard Firestop or Wet Area Firestop each side of 92mm CS Studs at 600mm max centres & 2.0mm thick steel security sheet between layers of Plasterboard one side. Mass 63 kg/m²	STC 56 glass wool - min 75mm 25kg/m³ (92 CS 55)
	Non load-bearing	Limiting Height mm (max) 0.25kPa / Width mm / Studds mm / Studds BMT (mm) 5210 d / 158 / 92 / .55 5730 d / 158 / 92 / .75	Ref. Acoustic System ASS18
SS9	Non fire-rated partition	13mm Boral Plasterboard / Width / 13mm Boral Plasterboard Steel Stud Partition - 1 layer 13mm Boral Plasterboard Standard Core each side of 51, 64, 76, 92, &150mm CS Studs @ 600mm max centres. Mass 21 kg/m²	STC 36 no insulation (64 CS 55)
	Non load-bearing	Limiting Height mm (max) 0.25kPa / Width mm / Studds mm / Studds BMT (mm) 3210 d / 77 / 51 / .50 3230 d / 77 / 51 / .55 3740 d / 90 / 64 / .50 3780 d / 90 / 64 / .55 4230 d / 90 / 64 / .75 4440 d / 90 / 64 / 1.15 4160 d / 102 / 76 / .55 5030 d / 102 / 76 / .75 5230 d / 102 / 76 / 1.15 4980 d / 118 / 92 / .55 5520 d / 118 / 92 / .75 5760 d / 118 / 92 / 1.15 7010 d / 176 / 150 / .75 7660 d / 176 / 150 / 1.15	STC 44 glass wool - min 50mm 10kg/m³ (64 CS 55) Ref. Acoustic System ASS2

Fig no 7: system selector

- Limiting heights shown are for a maximum intermittent lateral pressure of 0.25kPa in a non-fire environment.
- Limiting Heights shown are based on Structural Limiting Height governed by Deflection l /240 (d), Strength (s) or End reaction (r). End reaction refers to the manner in which the stud is retained in the top and bottom trackvi.e. friction fit or rigidly fixed.
- Mid-span nogging is recommended for erection purposes in walls higher than 3600mm.

5.3 Wall systems

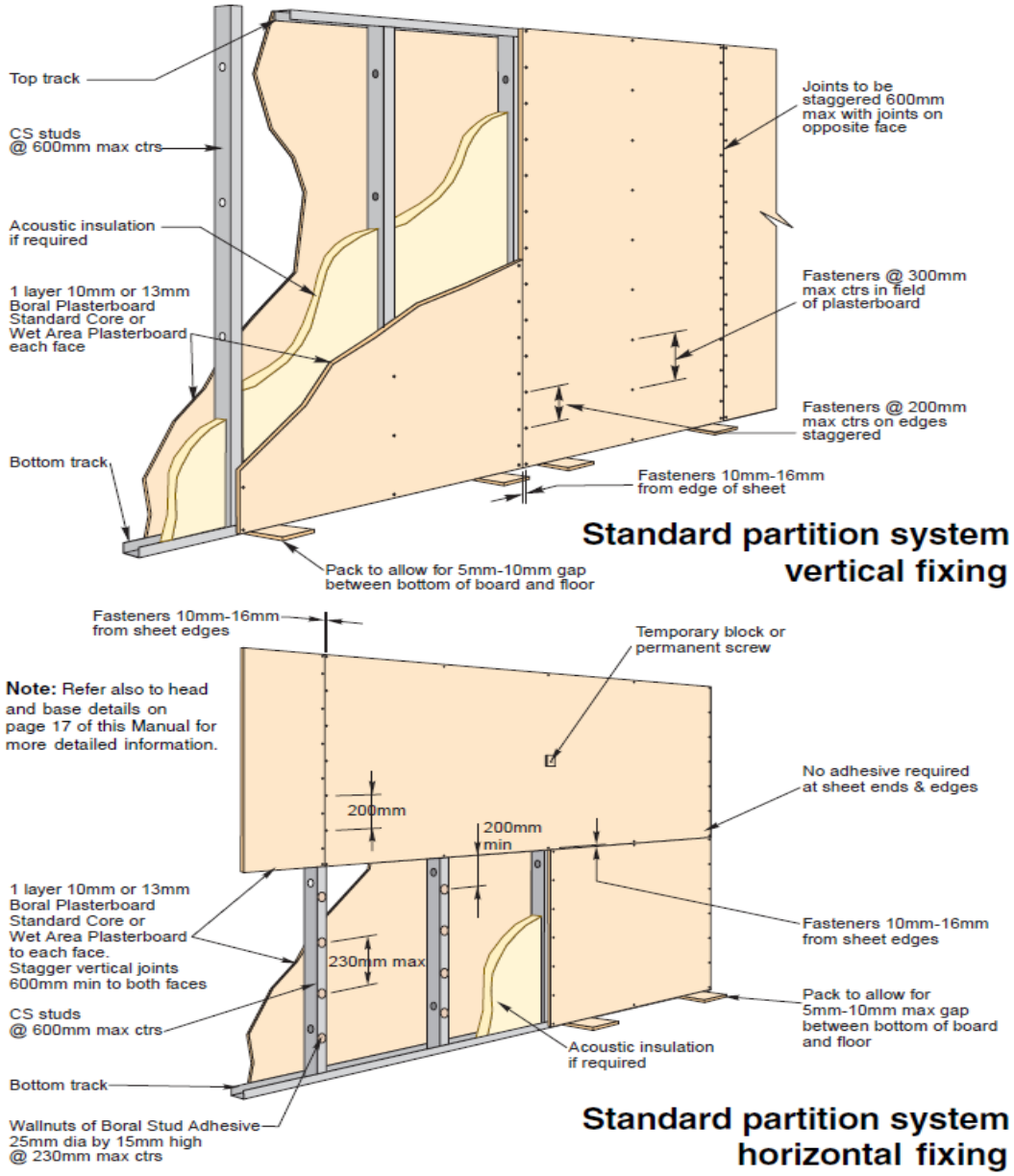
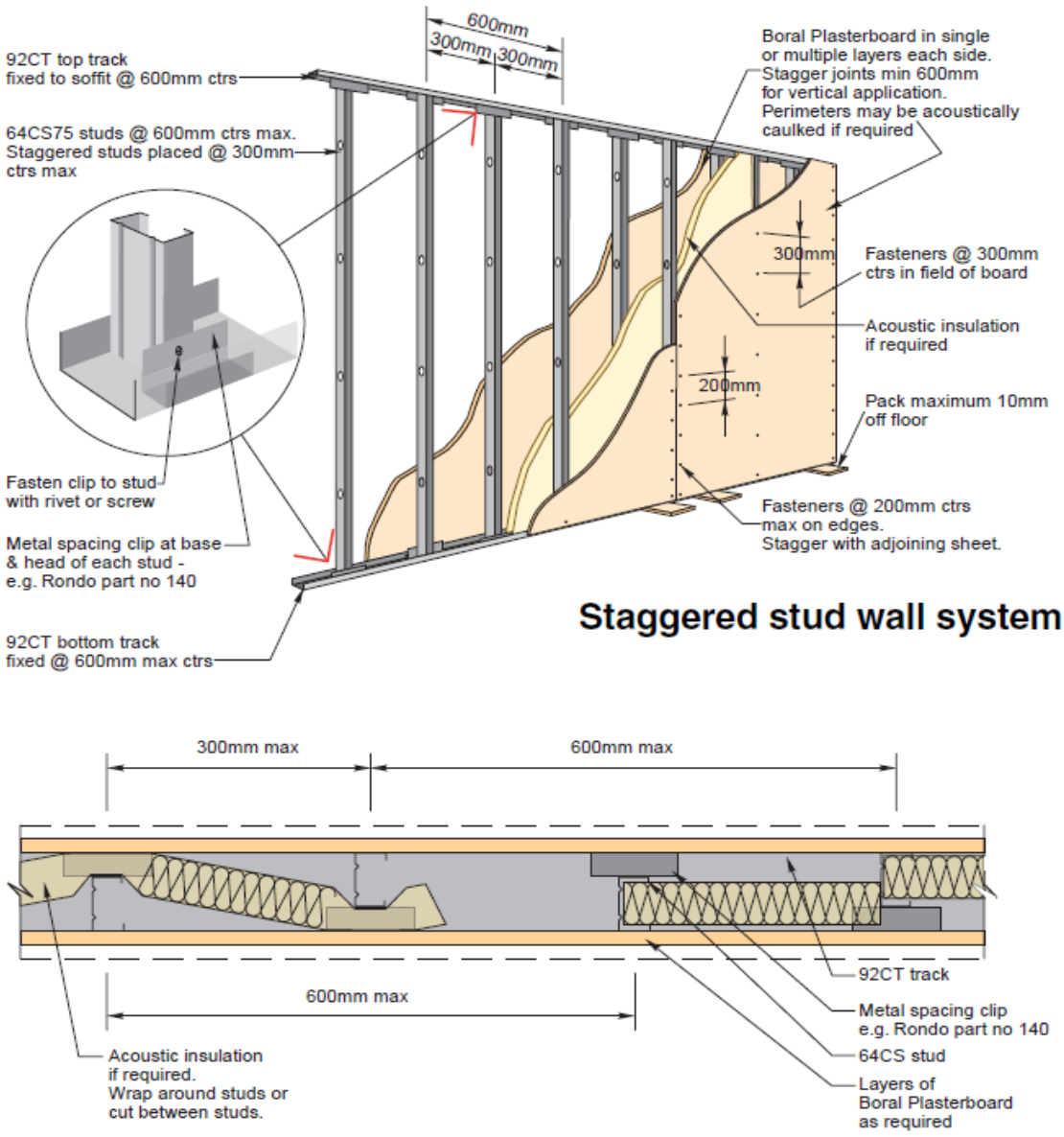


Fig no 8: standard partition system horizontal fixing



Staggered stud wall system plan detail

Fig no 9: staggered wall

Staggered stud walls can achieve impact sound isolation and excellent STC ratings, so can be used as party walls, or wherever good acoustic insulation is required.

5.4 Special wall systems

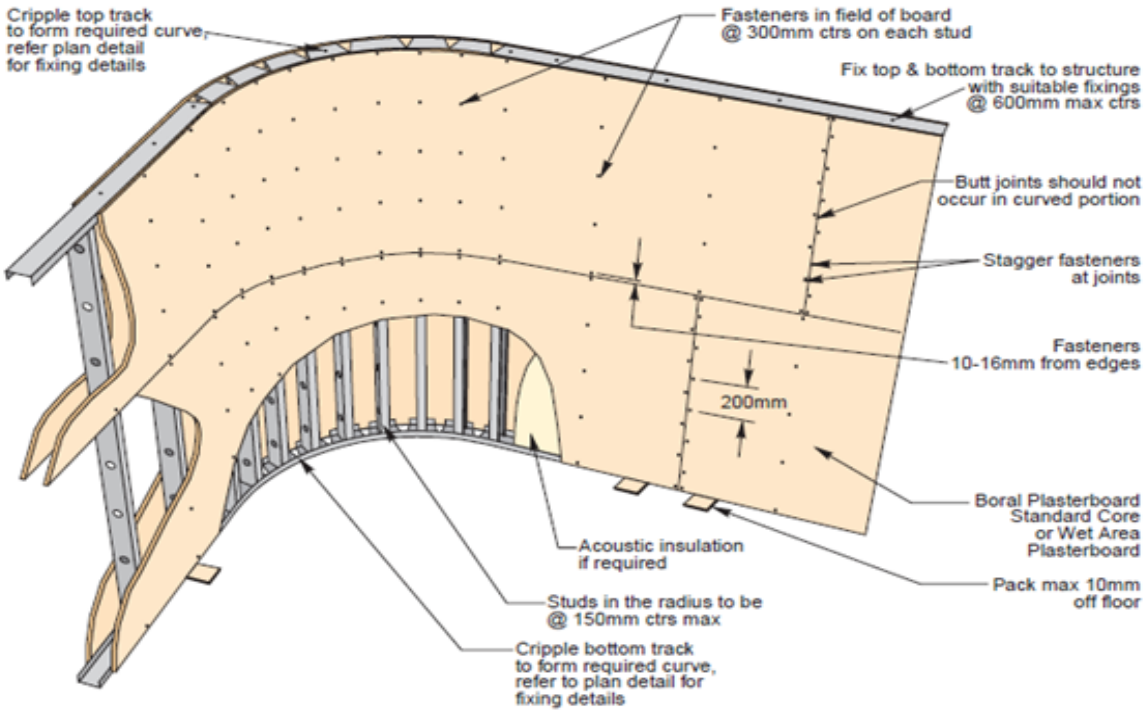


Fig no 10: curved wall

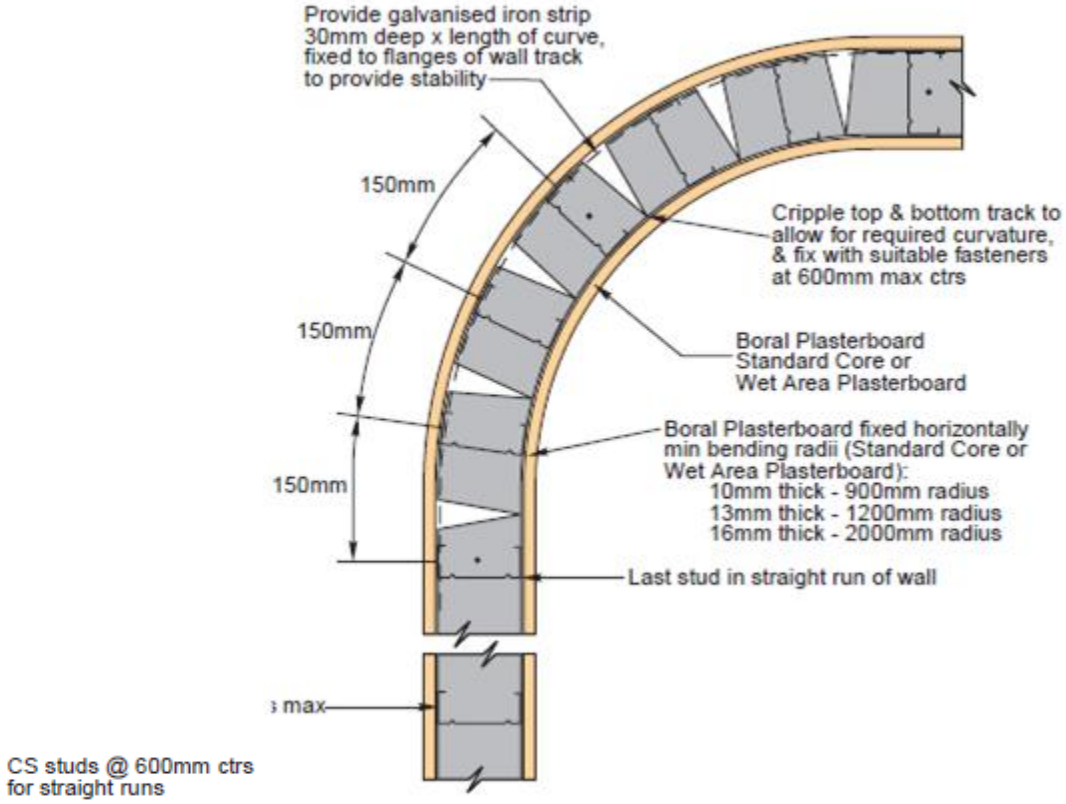


Fig no 11: curved wall plan

By moistening the face and back linerboard thoroughly the sheets may be curved to shorter radii. When plasterboard has dried it will regain its original strength. Alternatively, using Boral Plasterboard's 6.5mm flexible plasterboard, tighter radii may be achieved: concave horizontal: 650mm radius convex horizontal: 450mm radius To prevent flat areas between framing, space studs closer together than normal. The shorter the radius of the curve, the closer the framing spacing should be.

Direct fixing to existing walls:

This method applies to renovation projects where Boral Plasterboard Vision Impact Panels offer a smart alternative to a fresh coat of paint or new wallpaper. Verify good condition of existing wall. Plan panel placement. Arrange panels to obtain the best match in color or pattern. Make sure all surfaces are clean.

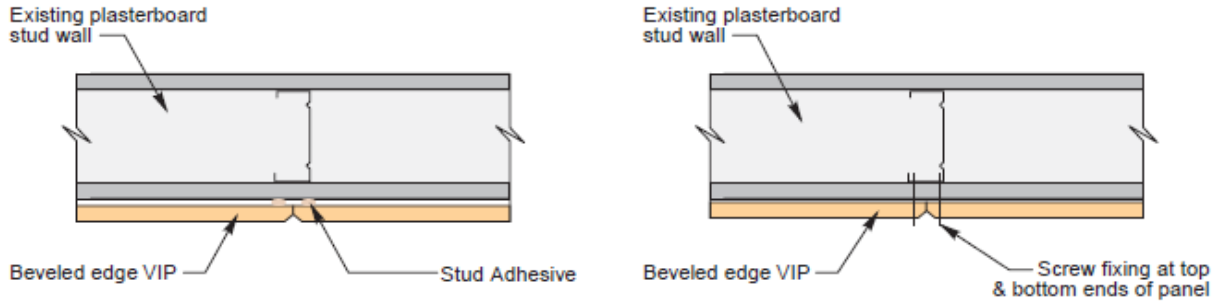


Fig no 12: direct fixing to existing walls

Concealed clips:

This is one of many methods for new construction. Concealed clips, fixed with screws to the timber or steel wall framing, hold Boral Plasterboard Vision Impact Panels in place along the long edges. As with direct fixing, use this method in conjunction with Stud Adhesive.

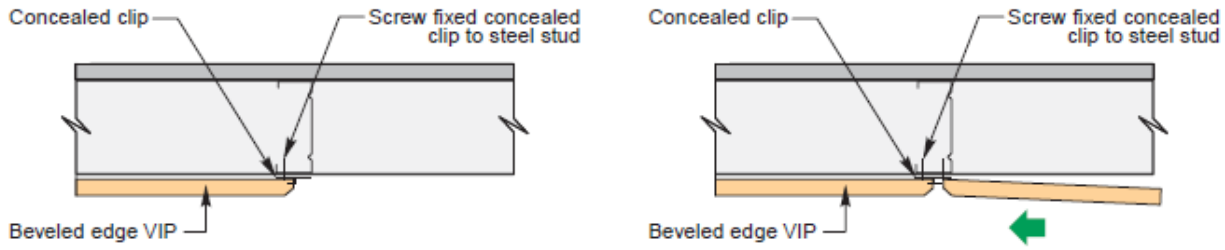


Fig no 13: Concealed clips

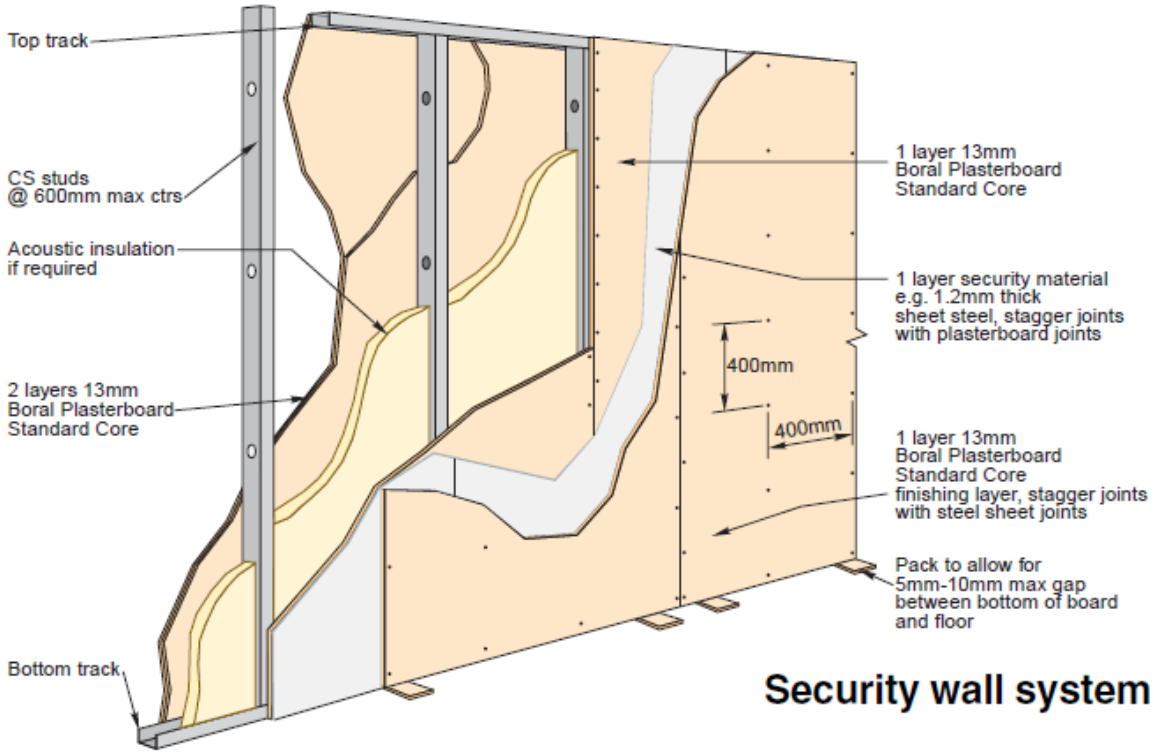


Fig no 14: Concealed clips

Other special walls

Plasterboard TecASSIST has been established for the specific purpose of providing information and assistance to you in construction detailing. For information beyond the scope of this manual, our technical desk - TecASSIST will be able to help you locate a system already in place or to offer advice that will meet your specific requirements. Situations requiring special wall systems might include:- cinemas and entertainment centers, banking facilities, shopping centers, multi residential projects, building recycling, concert halls, etc.

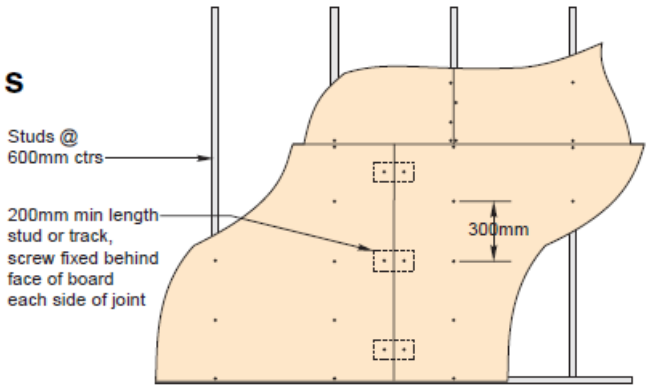


Fig no 15:Butt joint between studs

Where a butt joint occurs between studs in the first layer of a horizontal application, three sections of track or stud 200mm minimum in length are used. Screw fix the sections to each side of the joint slightly behind the face and space at 400mm minimum centres. Stagger joints on opposite sides of partition. Fasten with 25mm screws for first layer, 45mm screws for second layer.

5.5 Head & base details

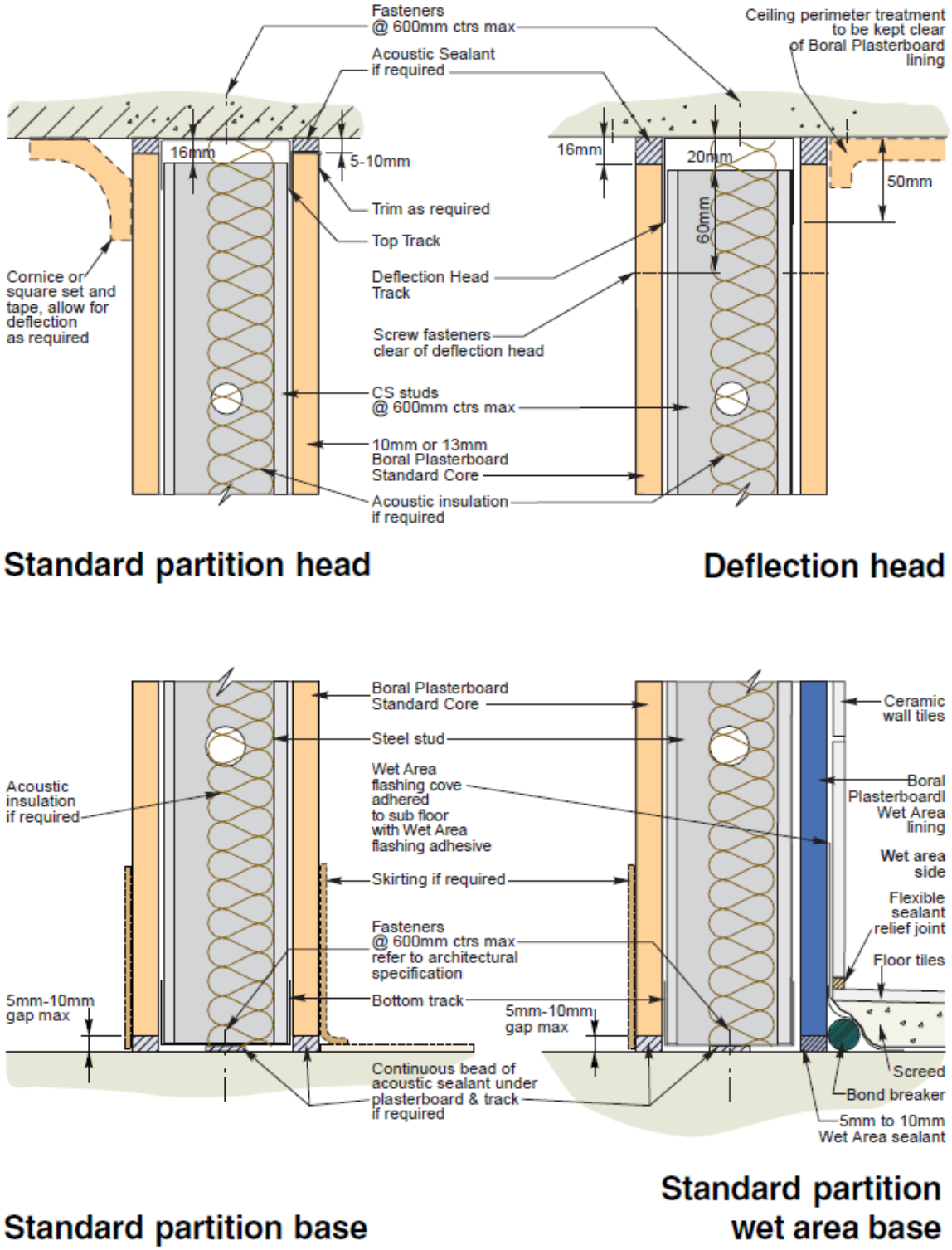


Fig no 16: Head & base details

5.6 Plumbing details

The following instructions must be followed to achieve satisfactory results:-

- Care should be taken to isolate copper pipes away from contact with steel framing to avoid problems
- with corrosion
- Plasterboard linings are not to act as supports for piping
- Piping is to be kept clear of face sheets

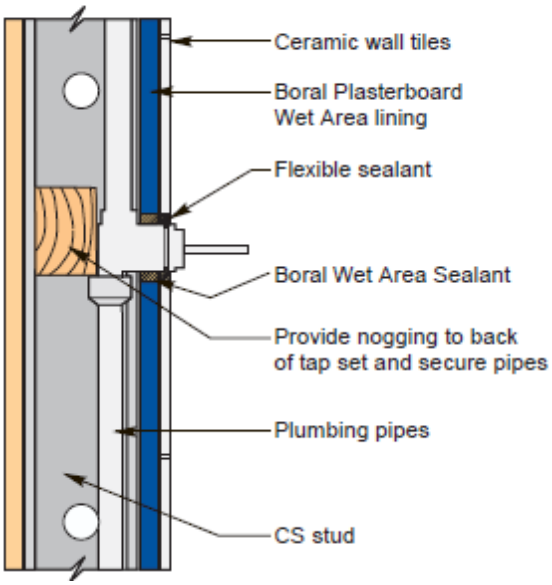


Fig no 17: Plumbing details

Typical plumbing penetration - section detail

Photo no 4

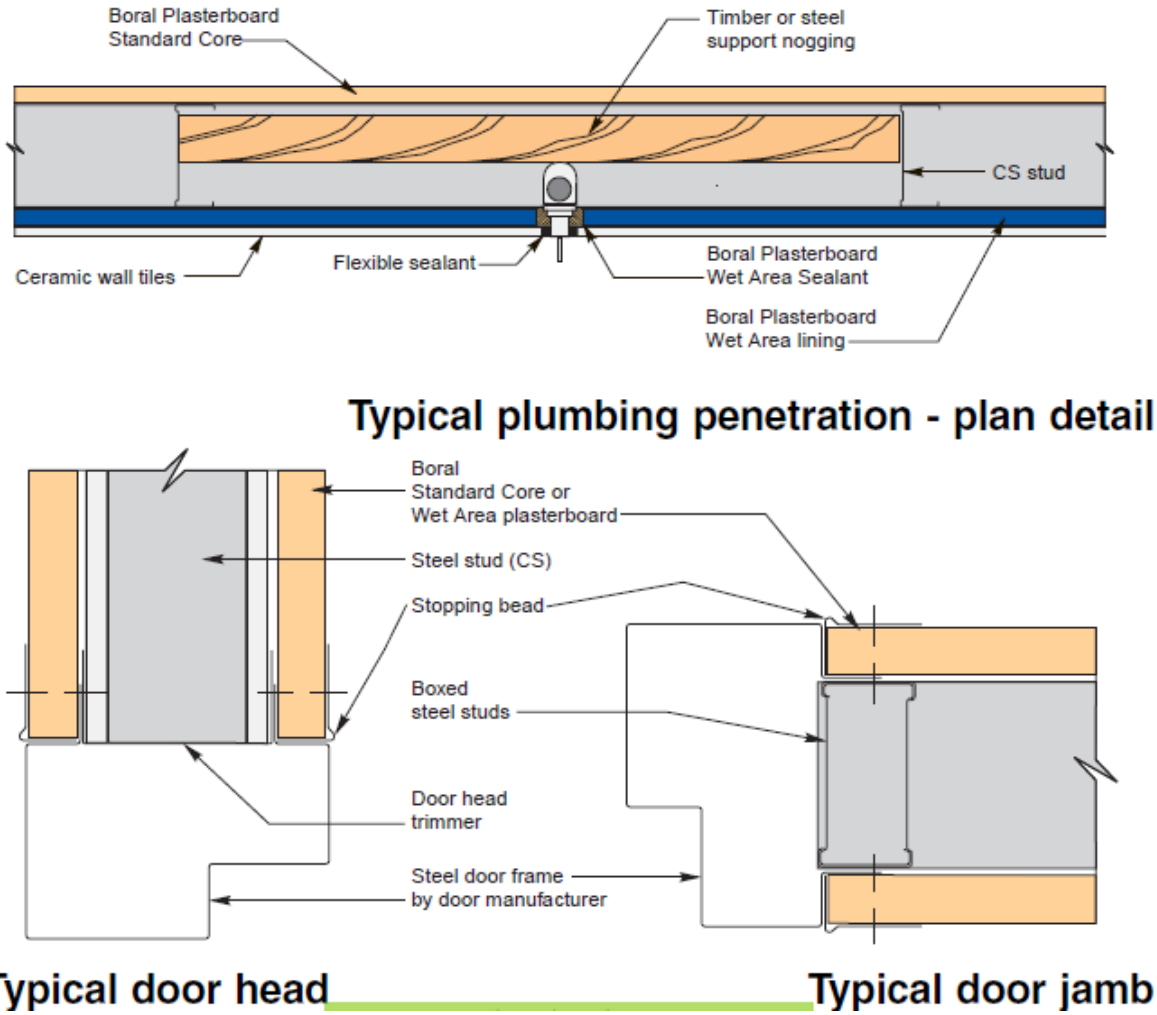


Fig no 18:plumbing

5.7 Door details

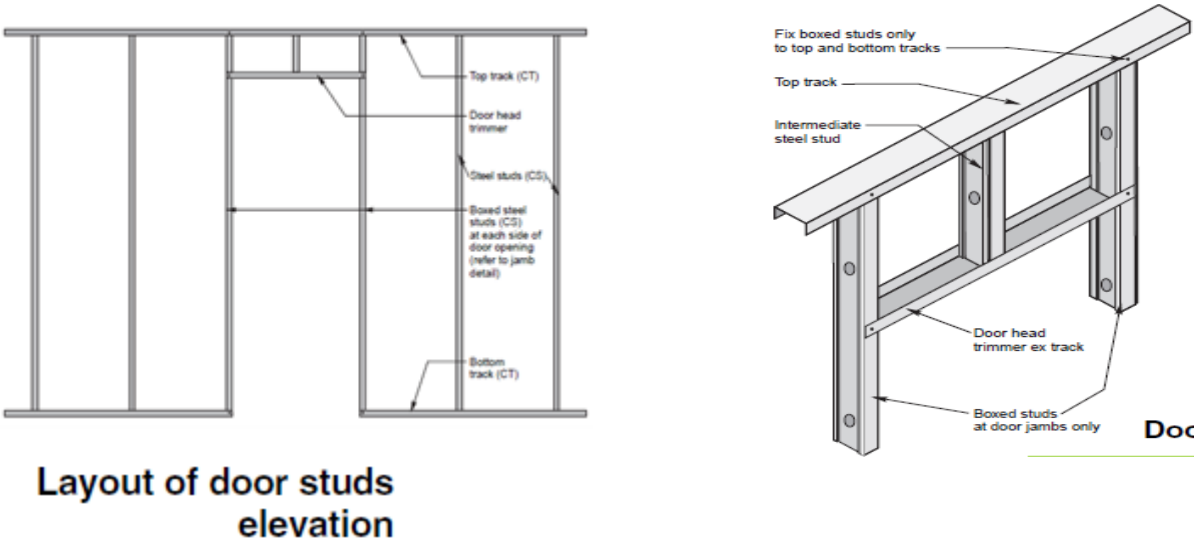


Fig no 19: door layout

Photo no 5: door layout

5.8 Terminals & junctions

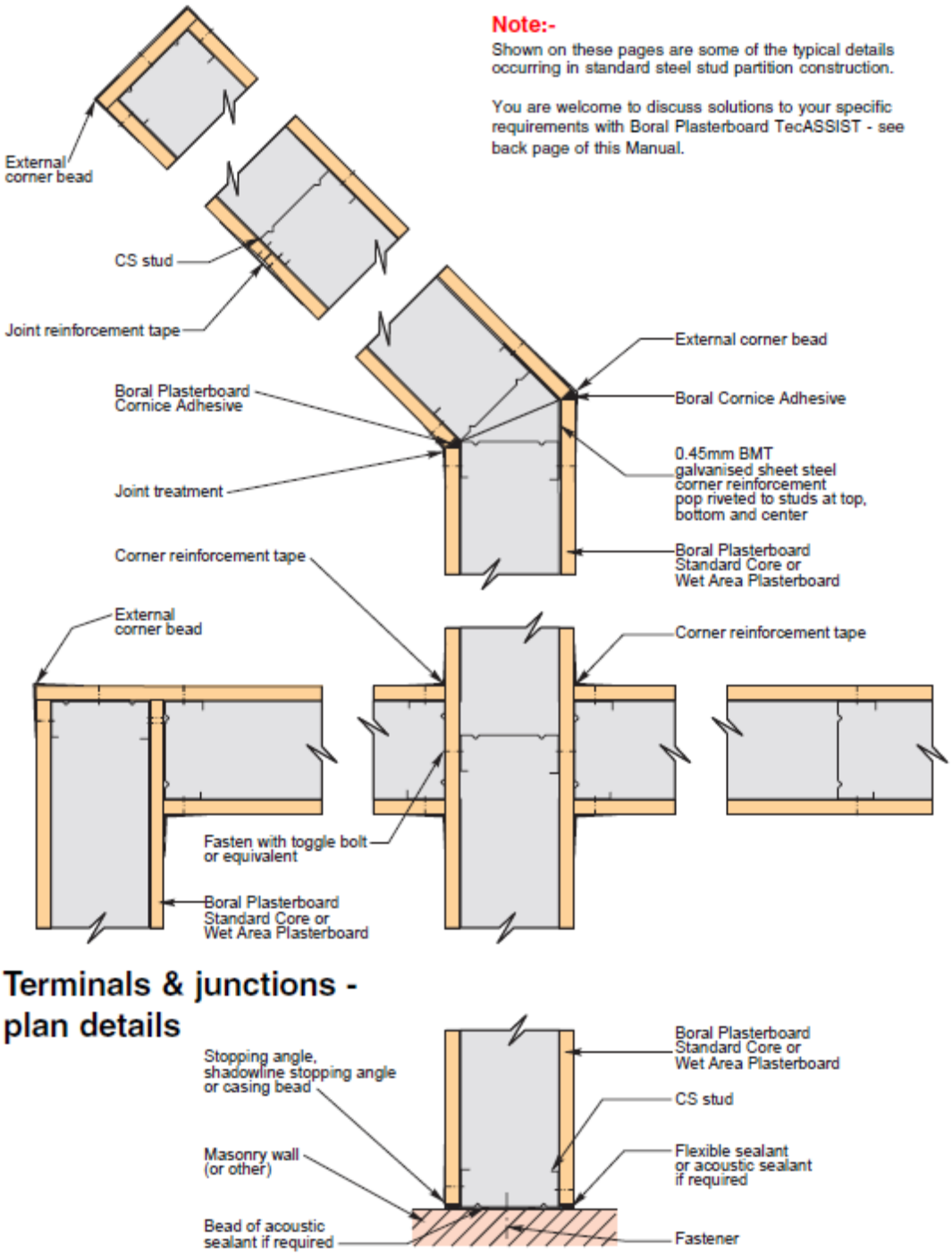


Fig no 20: terminals & Junctions

5.9 Control joints

Control joints must coincide with those occurring in the main building structure and/or at maximum 12 meter centres. Location of control joints should be verified with structural engineer.

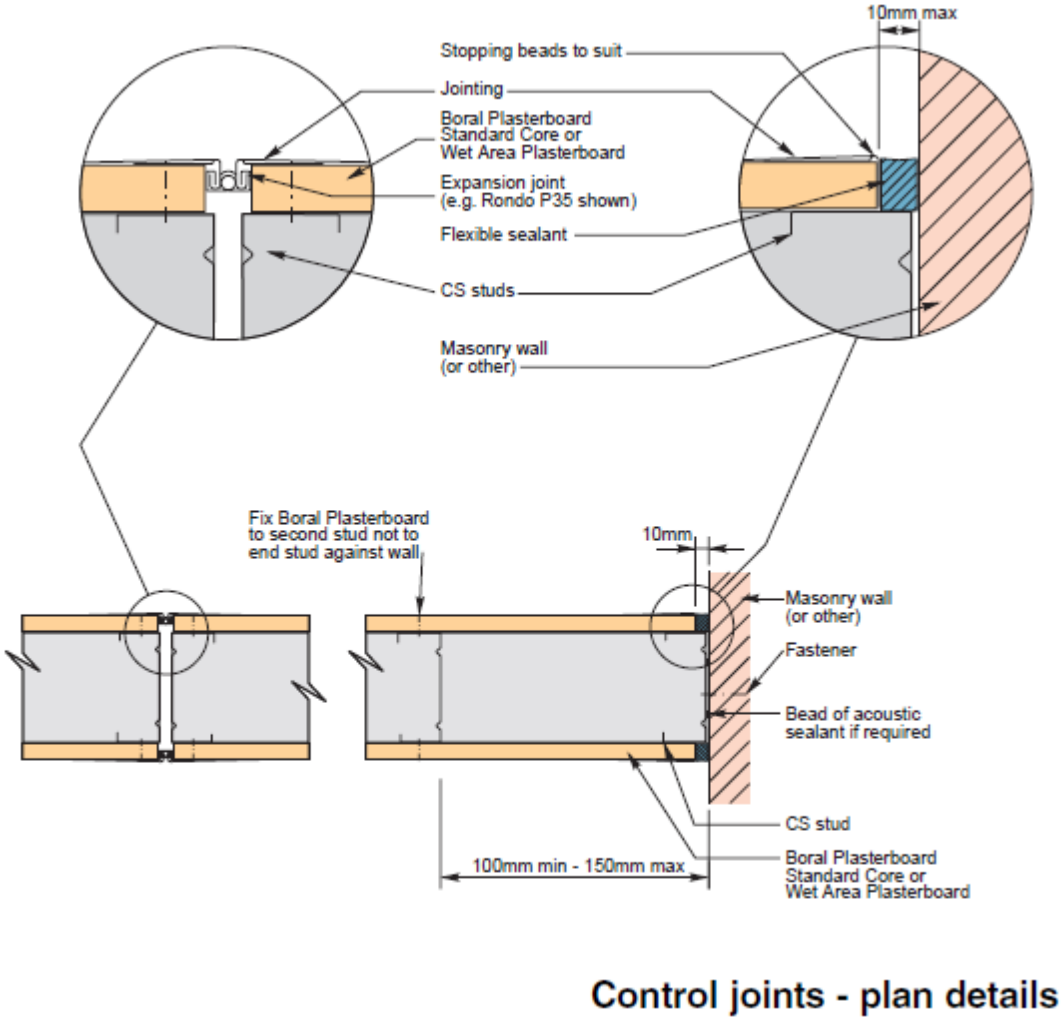


Fig no 21: control joint

Photo no 6: L & T joints

5.10 Materials

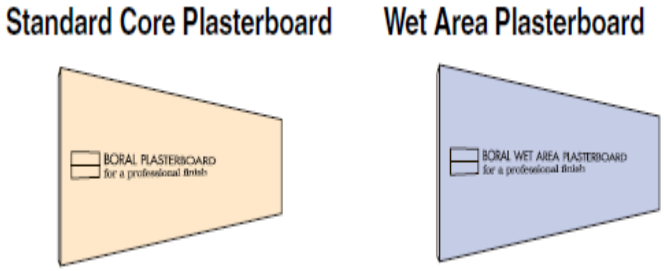


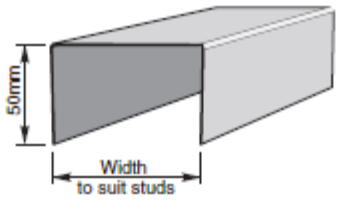
Fig no 22:Standard Core & Wet Area Plasterboard

Available in thicknesses of 10mm and 13mm. Sheets sizes are 1200mm & 1350mm wide to a variety of lengths.

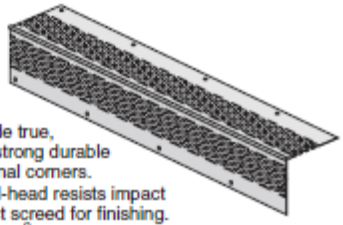
Use:

Boral Plasterboard Standard Core Plasterboard is ideal for lining walls, ceilings, beams and columns in residential or commercial construction. Plasterboard Wet Area Plasterboard is available for use in wet area applications.

Rondo Deflection Head Track

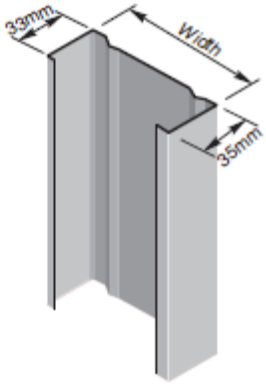


Rondo Corner Bead

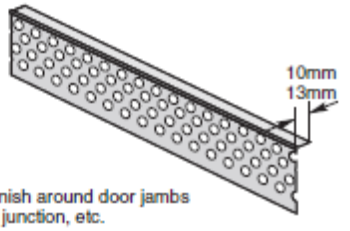


Use:
Designed to provide true, straight lines and strong durable protection at external corners.
The exposed bead-head resists impact and forms an exact screed for finishing.
Available in 90° & 135° angles.

Rondo Wall Stud

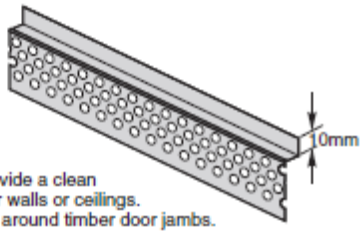


Rondo Long Leg Stopping Angle



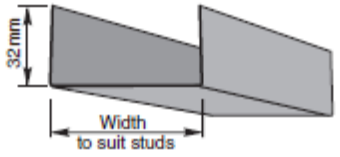
Use:
Provides a neat finish around door jambs or at wall / ceiling junction, etc.

Rondo Shadow Line Stopping Angle

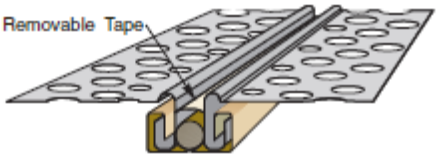


Use:
Designed to provide a clean straight edge for walls or ceilings.
Suitable for use around timber door jambs.

Rondo Wall Track

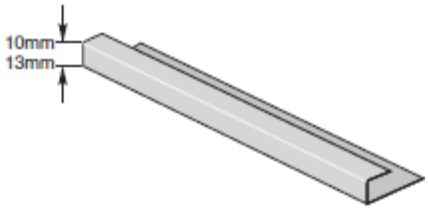


Control Joint Component (eg. Rondo P35)



Use:
Provides a finish to plasterboard control joints
Note:
This finishing section is not fire rated

Rondo Casing Bead



Use:
Suitable for finishing cut edges.

Fig no 23: Materials

VI. OBSERVATIONS AND CALCULATIONS

6.1 Preparation of checklist-

	QA/QC	**Check list NO :-**		
			Revision NO :-	
			Date :-	
	Project :-			
	Location / Room no. :-		**Date:**	
	Ref. Drawing no :-			
Sr.no	**Points to be checked**	**Checked by**	**Approved by**	**Remark**
	BEFORE STARTING WORK			
1	Check for availability of material on site.			
2	Check for Dry polishing of Mosaic flooring.			
3	Check for availability of final drawing on site.			
4	Check the clear maximum height of room is not more then stud of 3.125m & if so make proper provision to match the stud height. **DURING WORK**			
5	Check for approval of lineout from Sr. Engg. on floor , as well as on ceiling as per final drawing with respect to room dimensions , right angle, line etc.			
6	Check that screw fixing of track is done within 100mm from either end of track sections & rest at 600mm c/c by using Nylon plug screw or Dynabolt for fire rating wall or as per specification.			
7	Check that bottom track & deflection track are fixed in plumb.			
8	Check for orientation of stud is in same direction & service holes are aligned & are fixed not more then at 610mm c/c , except for toilets wall not more then at 405mm c/c.			

9	Check that for Deflection head track, 20mm clearance to stud is kept at top & stud is not been screwed or crimped to deflection head , except for door jam stud.			
10	Check that studs are been screwed or crimped with bottom track.			
11	Check that for door opening door head trimmer is been provided & studs are been screwed to both bottom & deflection head track.			
12	Check that studs are been boxed at door & window openings & at areas were extra loads are to be carried.			
13	Check that no studs are been spliced between 25% to 75% of wall height & is alternated top & bottom along wall & also splice length & its fixing is correct as per specification.			
14	Check that on RCC or brick wall Beta fix clip is been fixed at 900mm c/c vertically & Furring channel at 610mm c/c horizontally , except in toilet Beta fix clip at 600mm c/c vertically & Furring channel at 405mm c/c horizontally.			
15	Check that if extra slot if any, is been made at 3D from original slot & maximum till D in length , where D = Web width of stud.			
16	Check for Nogging track is been provided for wall height more then 4.4m as per specification.			
17	Check that studs are been adjusted as per plumbing , electrical & interior depts. requirement by keeping maximum distance between studs as per item no. 4.			
18	Check after completion of framing work for its right angles, line & plumb.			
	Remark :- Accepted/ Not Accepted/ Accepted under comments.			
	Comments :-		**Approved By QA/QC**	

6.2 Selection of Surface Finishing

SR. NO.	APPLICATION	DESCRIPTION
1	Temporary constructions	No jointing or finishing at all
2	Frequently used in plenum areas above ceilings and in areas that are generally concealed	All joints shall have the tape embedded in jointing compound. Surface shall be free of excess jointing compound but tool marks and ridges are acceptable
3	This finish is suitable where moisture resistant boards are used as a substrate for tiling and may be used in garages or warehouse storage where surface appearance is not of primary importance	All joints, angles and accessories shall have one coat of jointing compound applied. All screw heads to be spotted. Surface shall be free of excess jointing compound but tool marks and ridges are acceptable
4	This level is suitable for areas which are to receive heavy or medium textured paint finishes, or where heavy grade wall coverings are to be applied. Where lightweight vinyl's are to be used all joints etc. should be carefully sanded to provide a smoother surface.	All joints, angles and accessories shall have two separate coats of jointing compound applied. All screw heads to be spotted. All jointing compound shall be smooth and free of tool marks and ridges. It is recommended that all the areas of jointing compound receive a coat of suitable Primer before finishing.
5	This level should be used where gloss,semi-gloss or matt non-textured paints are specified. Any drywall that is subjected to critical lighting shall be finished to this level.	All joints, angles and accessories shall have two separate coats of jointing compound applied. All screw heads to be spotted. A thin skim coat of plaster shall be applied to the entire surface of the drywall. The surface shall be completely smooth and free of any marks and surface blemishes. The entire surface of the drywall shall receive a coat of oil based splaster primer before final decoration

6.3 Selection of Gypsum Board & Insulation materials

There are different types of drywall systems available in the market that offer a wide range of fire resistance and acoustic ratings to meet design requirements. The acoustic performance of the drywalls can be enhanced with the installation of rockwool between the boards.

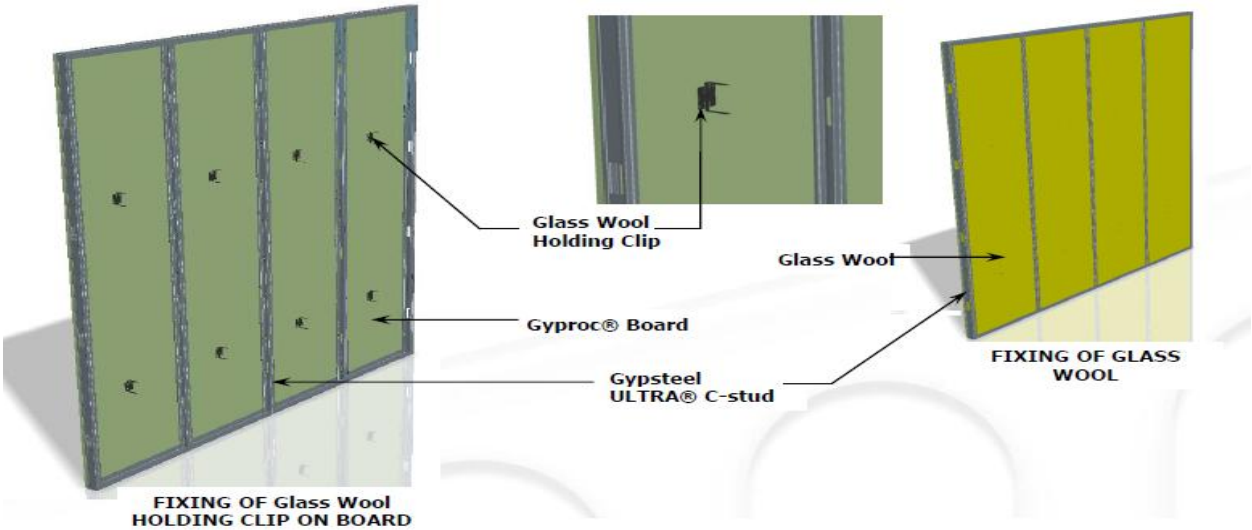


Fig no 24: Rockwool Fixing

Sound Transmission Class (or STC) is used to rate interior partitions, ceiling/floors, doors, window and exterior wall configurations. STC is the decibel reduction in noise a partition can provide. The higher the STC value, the better is the acoustic performance.

Interior walls with bricks or concrete walls have STC of about 40, which is considered as "onset of privacy", suitable within the residential units. The lightweight and dry partition walls have an STC of about 33 without any insulation. Adding insulation like rockwool in the wall cavity would increase the STC to between 45 -50. Hence, unlike brick or concrete walls where the STC is limited to the choice of material, the dry partition walls have the ability to improve on the sound transmission loss by increasing the space and insulation between the boards to yield an STC of as high as 63.

STC 25	Normal speech can be heard easily with this.
STC 30	Loud speech can be heard.
STC 35	Loud speech can be heard, but not understood.
STC 42	Loud speech can be heard only as a murmur.
STC 45	Must strain to hear loud speech.
STC 48	Only some loud speech can be heard.
STC 53	Loud speech cannot be heard at all.

6.4 Pre installation Precautions

1. Curtain Wall if any or cladding facade dead loads must be supported by the structure and not by the drywall system except as follows:

   Exterior lightweight cladding may be fixed over Gypsum Plasterboard Exterior Wall Systems screw attached to studs using stainless steel screws, clips, support bars and fastening methods according to requirements of structure.

   Cladding fasteners should be checked & approved by a qualified engineer. Fixing cladding system to the drywall substrate only is not recommended. Exterior cladding must be properly weather sealed for the life of the structure, particularly at ends, edges & joints, preventing condensation forming and leakages through to drywall construction.

2. In cold weather areas during plasterboard joint finishing, temperatures within the building shall be maintained within the range of 13°C to 21 °C. Adequate ventilation shall be provided to carry off excess moisture in environment.

3. To prevent damage from weather all materials shall be suitably protected during installation and construction

6.5 Installation procedure -

a) Step One

Set out the locations in accordance with floor plans ensure internal walls are perpendicular to external walls.

b) Step Two

Secure the top & bottom tracks in position using appropriate fasteners, at not more than 600mm centers. The first fastener should be no more than 100mm from the start or finish of each track or any opening. Deflection head tracks should be used for walls 4.8m & higher.

c) Step Three

Cut the stud to length –for friction fit this is 6mm shorter than the wall height & for deflection head this is 20mm shorter than the wall height.

d) Step Four

Fit studs into the per-punched hole & into both the top & bottom tracks with the service holes starting from the Bottom. Then, with twisting action, rotate the stud into position. Ideally the stud should be oriented in the same direction to make fitting the lining board easier.

e) Step Five

Fit the lining board to one side of the wall first. The lining board should be fitted such that the board is screwed to the open side of the stud first. This will prevent any misalignment of the board along the wall.

f) Step Five

Allow the service to run in the wall cavity.

g) Step Five

Line the second side of the wall, using the same method as the first, except that the joints in the lining board should be staggered. This is achieved by starting with half sheet.

h) Step Five

Set the all joints.

6.6 Comparison with Brick/Block Wall

Description	Precast Partitions	Brick Walls/Block Walls
Cost	Initial cost is higher, but saving in plastering, construction time and labour cost	Lower initial cost, but higher labour cost
Weight	3 to 4 times lighter than brick walls	Heavier loads on structural frames and foundations
Speed of erection	Four times faster than brick walls	Time-consuming
Plastering	Only thin plaster (10mm) is needed	Require thick plastering to obtain smooth surface
Wet trades	Not necessary	Necessary
Fire resistance	2 times better than brick walls	Poorer
wThermal Insulation	About 5 times better than brick walls	Poorer
Sound Insulation	Similar	Similar
Mechanical strength	Much lower	8-9 times higher than drywalls

VII. CONCLUSION

This technique drywall gives progress of work as per the schedule and there is no delay in the construction work for completion of work with less dead load as compare to brick work with minimum wastage and superior smooth finishing is achieved.

- This technique gives faster construction that is 3 to 4 times masonry construction.
- It reduces dead load of structure it gives 8 to 10 times lighter than masonry work.
- It gives use of recyclable material which is made of environment friendly material.
- It gives smooth finishing seamless & crack free surface, allowing ease of decoration via paint, tiles or wallpapers.
- It reduces cost of structure as it is lighter than masonry work.

In short this technique helps us to control on critical factors like Time, Cost & Quality in construction work which are necessary for success of construction industry.

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