



# *Healthier building*

*with gypsum products*

## **No. 5** **EFFICIENT BUILDING**

*This publication looks at various aspects of achieving a more efficient design and construction process using gypsum products. The subject is treated by presenting a number of case studies for different building types. These also show the application of guidance given in the preceding publications in the series.*

# GPDA

Gypsum Products Development Association

*This publication can form part of a structured programme of CPD  
(Continuing Professional Development)*

# I

## ntroduction

To build efficiently is to deliver the desired end product using the minimum of effort and resources for the benefit of the industry and its customers.

An accepted target for the construction industry is the 30% cost saving for clients recommended by Sir Michael Latham in his report - 'Constructing the team'. Many of the efficiencies recommended by the report relate to how the industry is structured and works together.

"The major potential cost savings arise in the earlier phases of a project. The early integration of the clients, consultants, contractors and specialists during conceptual and design phases will lead to performance improvements throughout the concept, design, construction and occupation phases."

*Towards a 30% productivity improvement in construction, CIB.*

Within this overall concept these are some of the recommended activities which relate to the use of gypsum products.

- "Make quality the main requirement of all elements of the design and construction process."
- "Health and Safety should be part of the cost benefit analysis."
- "Develop standard products, components and processes."
- "Improve designers' knowledge and understanding of the performance of components and materials."
- "Quality and value must not be ignored in pursuit of the lowest price."

*Towards a 30% productivity improvement in construction, CIB.*

### The Healthier Building Campaign

The series *Healthier Building with Gypsum Products* addresses current concerns about the impact on health, the environment and efficiency of the way we build.

The series covers five topics:

1. Health and Safety - The CDM Regulations & Safety, Health and Welfare At Work (Construction) Regulations (July 1997)
2. Sustainable Development (July 1997)
3. The Building Regulations (July 1997)
4. Reduction of Waste (March 1998)
5. Efficient Building (March 1998)

The series is aimed at members of the design team and contractors. It is not intended to provide detailed design guidance, which is readily available in manufacturer's product literature, but rather to raise awareness of the issues involved.

The publications can form part of a structured programme of CPD (Continuing Professional Development).

To build efficiently therefore with regard to gypsum products requires a firm grasp by designers, specifiers and constructors of the potential of gypsum products, their suppliers and the specialist installers.

The recent developments in gypsum products offer the potential for increased efficiency in a number of areas.

- Steel framing systems which are gradually replacing timber stud work offer a number of advantages in terms of tolerance, services and quality.
- Special products and systems whose performance characteristics are suited to particular applications e.g. shaft walls, acoustic walls, moisture resistant and fire resistant materials.
- Jointing and fixing systems and tools to speed the installation process.
- Specialist assistance to develop and test specialist applications.
- Management expertise to co-ordinate design, supply and installation.
- Efficient delivery and handling systems to suit specific projects and sites.

The following case studies illustrate some of these aspects in action.



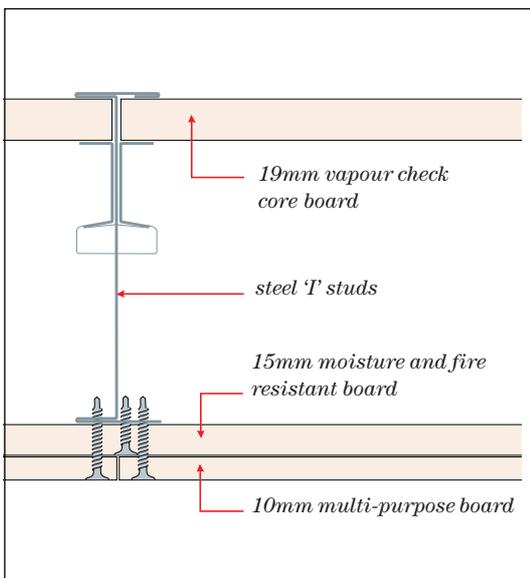
## BA World Cargo Centre

The new cargo centre for British Airways at Heathrow Airport will be fully functional on 1st January 1999 providing storage and handling for 800,000 tonnes of air freight per annum.

The design required the construction of two separating walls between air side and land side, 300m long and 20m and 25m high respectively. The walls needed to provide a 1-hour fire rating. They also needed to be capable of withstanding 80mph winds and be water-resistant as they would be partially unprotected from the weather during the construction period.

The main structural frame consists of steel beams at varying centres running the length of the wall which support the separating walls.

The original specification called for an integral board system. However, the adopted solution was based on a value engineered exercise undertaken by the trade contractor to find the most cost effective



*Detail of the 1 hour fire resisting wall*



*The vapour check core board being fixed from the scaffolding behind*

way of meeting the performance required. Their specification was then underwritten by the system supplier.

This solution is a shaft wall system which is capable of being constructed from one side only - another criteria of the brief. The shaft wall consists of steel 'I' studs with a 19mm vapour check core board fixed inside the stud on one side with a 15mm moisture and fire resistant board and a 10mm multi-purpose board providing the finished surface on the other.

The studs span between the main structural beams but are positioned to provide a continuous fire resistant surface on one side of the wall with special detailing to provide movement joints both horizontally and vertically. Because of the large dimensions involved, particular care had to be taken with tolerances and fixings as much of the structural integrity of the wall is provided by the boards themselves which are staggered to increase its strength.

The scale of the project made it cost effective to order the studs and boards manufactured to the specific varying dimensions required by the structural frame. As a result of this, wastage levels were reduced to about 1% of the delivered products. Even then, much of this wastage was due to the unavoidable need to cut boards for openings and stairwells.

Very little site storage was required: the materials were scheduled for delivery in 24 tonne loads according to the section of the wall being worked upon. Materials were off-loaded onto pallets and moved mechanically through the site and onto the scaffold where the materials were required.

*Client:* BA World Cargo Ltd

*Designers:* W S Atkins

*Construction Managers:* LMK Ltd

*Drylining trade contractor:* Measom Dryline Ltd



*A close up of the 15mm and 10mm boards being fixed*



*The moisture and fire resistant board being fixed*

The shaft wall system of construction was originally developed for lift shafts, but is being increasingly used for large applications such as warehouses. The system allows construction from one side only. The resulting wall is approximately 25% of the weight of the corresponding wall made in blockwork and takes about half the time to install.

*Further examples:*

Western International Distribution Centre, Dublin

Broadgate and Canary Wharf lift shafts.



*The reception area to the Jury's Custom House Inn*



## **Jury's Custom House Inn, Dublin**

The Jury's Custom House Inn demonstrates the use of gypsum wallboard in producing a large quantity of partitioning to an agreed performance and at high speed.

This three star hotel for the Jury's Hotel Group is located in the Custom House Dock district, a development area near the International Financial Services Centre. Construction of the £8 million hotel began in 1995 and was completed in 15 months. With seven floors and 234 bedrooms it is one of the largest hotels in Ireland.

The main structure is in-situ reinforced concrete with predominantly brick and block cladding interspersed with glazed curtain walling and aluminium cladding.

### **Internal partitions**

Internal partitions were required to provide up to 1-hour fire resistance and an acoustic separation of 50 dB. To achieve this a gypsum wallboard solution was chosen because it could both meet the performance requirements and was also the quickest and most economic option from a construction point of view.

The partitions consisted of a 70mm metal frame with insulation over which a double skin of standard gypsum wallboard was fixed and jointed as recommended. As is usual in the Republic of Ireland, the partitions were finished with a plaster skim. The plaster skim finish was generally painted and other areas were tiled or sheeted.

The partition work, which began in January 1996, was notable for its speed. This was aided by a number of factors: the contractors had already undertaken projects for the client and were familiar with their requirements and methods of

working. A mock-up of a standard room unit was created to iron out any problems before the major work began. The construction work was phased to allow

work to begin early on the partitioning. The contractors were also able to take advantage of the storage such a large site offered to ensure that the supply of materials was handled in the most efficient manner.

The manufacturer/supplier was also able to assist through the following measures:

- comprehensive technical support at the design stage was provided to optimise the specification with regard to speed of construction
- loaded trailers were delivered to site for off-loading as crane availability permitted; trailers were often left for 24 hours
- timed deliveries to site allowed for crane booked time
- deliveries were arranged to suit product requirements of plastering subcontractors
- lifts of standard and special boards were mixed to suit the subcontractor's production requirements
- some lifts of boards were shrink wrapped to allow the lifts to be put on floor decks while the building was still open to the elements.

*Client:* Jurys Hotel Group

*Design & Build Contractor:* P J Hegarty & Sons

*Architects:* Burke Kennedy Doyle & Partners  
*Dry lining Subcontractor:* P JRigney & Co Ltd



## Stratford Picture House

The new four screen Picture House in Stratford, London demonstrates the efficient use of drywall systems to create both architectural features in the public circulation areas and sound insulation performance in the external and partition walls.

### 1. Shell works

To give enhanced sound insulation external wall linings are independent of the structural steel and cladding. They are constructed using two layers of 12.5mm fire resistant board, fixed to 90mm metal 'T' studs, incorporate 50mm of insulation and provide 1-hour fire protection. To provide added durability, internal faces in key areas such as those housing WCs are lined with moisture resistant wallboard.

Much of the structural steelwork is hidden within the auditorium partitions which are cross-braced, twin 90mm 'T' stud constructions faced with double 12.5mm fire resistant board. Framing for each side of the partitions incorporates 60mm of insulation giving overall sound separation >68dB Rw.



*An elliptical barrel ceiling formed from gypsum wallboard*

The complex nature of the project and the amount of non-standard installation called for close liaison between the designers, subcontractors, the manufacturer's technical team and main contractors with a number of special details being developed specifically for the project as it went along.

### 2. Fit out

The interior layout is influenced by the constraints of a narrow site which calls for a steeply raked auditorium to create space below for circulation areas and booking office / catering facilities.

An elliptical barrel ceiling running the full length of the 40 metre building provides a pleasing feature which covers the heating and ventilating equipment and services to the projection suite above it. Corridors incorporate subtle curves, whilst partitions and stair balustrades are angled at 30° from the vertical.

These effects, which were part of the architectural goal, were achieved whilst maintaining the high standards of thermal and acoustic insulation required to ensure comfort and performance quality for audiences.

The barrel ceiling consists of a close tolerance metal framework, which can be adjusted after installation to achieve the exceptionally accurate alignment required for a ceiling of this size. Two layers of 6mm gypsum wallboard were then screw-fixed to the frame and shadow line feature reveals were incorporated at 1,200mm centres.

Sloping internal corridor walls use boxed 146mm metal 'C' studs, with two layers of 12.5mm fire resistant wallboard. Partition thickness and insulation vary according to



## Wimpey Homes

location and function. Fire resistant wallboard is used where higher levels of fire protection (and sound insulation) are required. Moisture resistant board is used in WC areas and moisture and fire resistant boards specified internally for lining structural curtain wall studding.

*Architects:* Burrell, Foley and Fisher

*Main Contractor:* John Sisk

*Subcontractor:* OCL

Wimpey Homes is constantly reviewing its design policy to incorporate new products and techniques into its new housing. As a volume house builder, Wimpey Homes is able to evaluate the efficiencies offered by new products and systems which even though minor, may make a considerable impact on customer satisfaction and efficiency when applied across the whole group.

Gypsum boards are used for lining ceilings (nailed to the under-floor joists), internal structural walls (usually fixed with dabs) and to create internal partition walls.

The most recent change in drywall partitioning has been a gradual move away from some conventional partition systems. Following numerous site trials in conjunction with subcontractors and with manufacturers' assistance, metal stud partitioning to which the wallboard is screw-fixed is now replacing previous systems.



*Sloping internal walls*

The use of drywall systems for producing partitioning within multiplex cinemas is becoming increasingly common because of the speed of construction and the performance which can be achieved compared with the weight of materials used.

*Further examples:*

Nynex Cinema, Manchester

Guildford Multiscreen

Showcase Cinemas, Bristol and Stockton on Tees



*Battery-powered hand tools for screw-fixing wallboard to the metal frame*



*Services are easily accommodated within the cavity*

The metal stud partition is slightly wider than the integral system it replaced. A review of the overall design of the house ensured that room dimensions would not suffer as a result. Minor details such as an increase in the width of the door linings also had to be incorporated.

It is estimated that the cost and installation time for the metal stud system is equivalent to the previous partition system. However there are definite advantages in terms of performance.

There was an initial resistance to metal stud partitioning, as it was perceived as being less structurally robust. The opposite is probably the case particularly where piped and electrical services have to be run within the partition. With the metal stud system these are easily accommodated within the cavity; previously channels had to be cut which had an effect on the overall stability. At corners and at 'nibs' the metal stud partition also has greater robustness. The metal studs are also more flexible under impact which adds to their comparative durability.

Screw-fixing to metal studwork also has advantages over nail fixing to timber. There are no shrinkage problems, which eliminates the risk of cracking and damage to finishes due to movement. The resulting partition

walls also have a better acoustic performance.

Another advantage of the new stud system is that the sub structure of metal frame work is incorporated into a single subcontract package.

The components of a metal stud partition are lighter and easier to manhandle, which is preferred by the installers. This is therefore a positive response to the requirements of the CDM Regulation, which require designers to consider the risks to those handling and installing the materials.

The metal stud partition also provides a solution to satisfying the IEE Wiring Regulations which need cables to be positioned so that there is no likelihood of drilling from the opposite side of the wall hitting the cables. The cables can now be run in the safety zones within the metal studs, doing away with the need for conduits.

The internal partition walls are still finished in the same way. The wallboard joints are taped and filled and then sanded ready for decoration.

*Contractor:* Wimpey Homes

*Subcontractor:* Various



*Central heating pipes within the partition*



## Medway Hospital

This project demonstrates the efficient use of drywall systems to create heavy-duty highly serviced internal partitions. It also demonstrates the new use of gypsum-based floor screeds.

The Medway NHS Trust has reorganised its hospital capacity by creating a 256-bed extension to the Medway hospital in Chatham with a project value of £37 million. The extension will be handed over in phases from April 1997 to November 1998.

### 1. Internal partitions

It is estimated that there are over 7 miles of internal partitioning in the hospital extension representing over 5% of the project value. In a standard 6-bed ward there is provision for various medical gasses, electrical/lighting, television/data, plumbing and drainage. It was decided that all of these should be contained within the partitions.

The key performance characteristics of these partitions are:

**Acoustic** - separation of noise between, for example, adjoining plant rooms and operating theatres, corridors and wards.

**Rigidity** - most partitions are approximately 4m high with horizontal services running above a suspended ceiling at 2.5m.

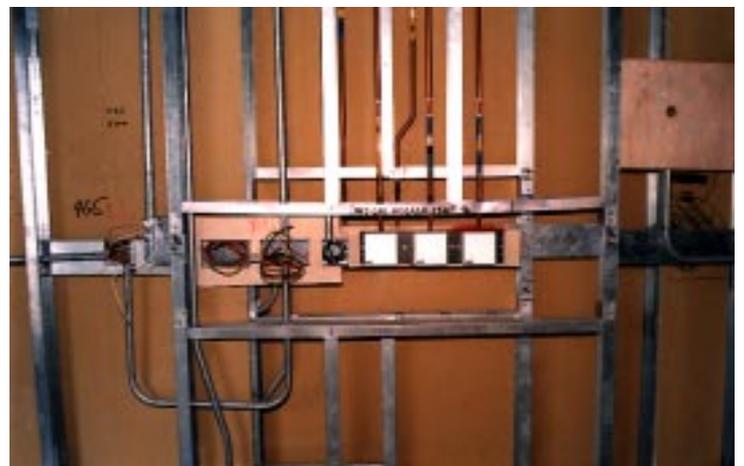
**Resilience** - the heavy servicing requires a large number of openings within the partitions with frequent stresses at these points. Impact of trolleys against the partitions is another characteristic of hospital use.

To achieve this the designers opted for a 100mm metal stud partition base on a 70mm 'I' stud to give the walls rigidity. The

manufacturers even developed a special system for metal door frames to replace the traditional timber sub-frame. The frame was lined with a high density, high impact 12.5mm gypsum board and included internal insulation in the stud cavity where acoustic performance was a requirement. High impact boards are more robust than standard gypsum boards: they provide the necessary performance without the need for a double skin, therefore reducing materials and fixing costs. Particular attention is given to fixing systems for this type of board.

To maintain the acoustic integrity of the partitions, detailing was required for where services penetrated the partitions and where they abutted the external walls to which they could not be fixed.

The heavy servicing required close liaison between the designers, services and dry lining subcontractors. Trial areas were set up to iron out any co-ordination problems. A sequence of work was established starting from the setting out of the metal frame through the installation of the services both above and below the ceilings and then



*'High level of servicing' - a standard bed-head prior to final fixing of wallboard*

signing off by the client prior to installation of the final skin of the dry wall partition.

To finish, the partitions were taped and jointed, primed and painted prior to installation of the suspended ceiling. This avoided 'cutting-in' by the painters if the ceiling went in before painting.

Handling: the boards were transported to the workface on special trolleys.

## 2. Floor screed

Gypsum floor screed is relatively new to the UK. The floor slabs were originally designed as a lightweight concrete slab with a 50mm cement screed. After careful trials however the contractors adopted a 30mm gypsum screed laid on a normal concrete slab separated by a polythene membrane and with additional insulation. This helped the acoustic aspects of the project, but the chief benefit to the project was the speed of installation (up to 1300m<sup>2</sup> in one particular day) and access by other trades within 24 hours. The resulting floor has a guaranteed minimum strength of 40N/mm<sup>2</sup> and a 15-year product warranty.



*Gypsum floor screed being laid...*

*...and ready for fixing floor plates*



*Services running above the suspended ceiling*

## 3. Additional uses of Gypsum board

Other major uses of gypsum in the project were fire protection to steel columns finished with a plaster skim and for lining of ceilings.

*Design & Build Contractor:* Kier Build Ltd

*Architects:* HLM Architects

*Dry lining Subcontractor:* Baris

The use of drywall systems for partitioning within hospitals is becoming increasingly popular. It is quicker than equivalent masonry systems and avoids the need for cutting chases for services, and reduces the foundation sizes needed. The taped and jointed board alone does not lend itself to a high gloss finish, desired by some hospitals, but if the partition is 'skim' finished this can be easily achieved. Another example of a new hospital using extensive dry wall partitioning is the newly completed Chichester Hospital.



*Moisture resistant board was used for the swimming pool ceiling*



## Lawress Hall Training College, Riseholme

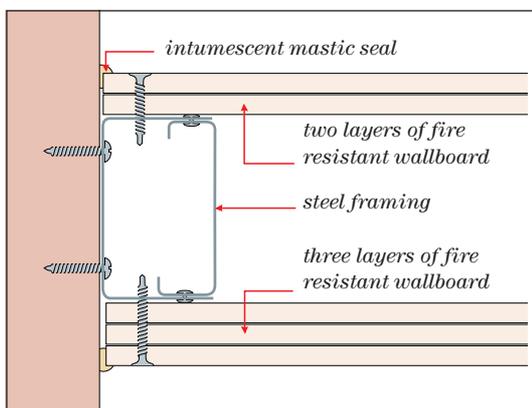
The £8 million residential training facilities created for the Inland Revenue contain 10 lecture rooms, a 130-seat conference centre, 123 bedrooms and hospitality facilities including a bar and a swimming pool.

It demonstrates, in particular, the use of moisture resistant boards in special applications such as the swimming pool ceiling.

### 1. Standard details

Acoustic performance of the partitions was the prime performance consideration. The performance of proposed metal frame with insulation lined with 2 layers of standard 12.5mm wallboard was verified by both laboratory tests but also the client visited other buildings where this had been installed to see the system in use. Where higher performance was required 15mm boards were used. This compared favourably in terms of weight and dimensions with the equivalent masonry wall.

The project also required 1 and 2 hr fire walls around the fire fighting lobbies. This was again achieved with a metal framing system this time lined with 2 layers of fire resistant wallboard on the outer face and 3 layers on the inner face.



*Detail of the 2 hour resisting partition*

### 2. Swimming Pool Ceiling

A dry system was used to line the ceiling of the swimming pool area and to create a curved feature above the pool.

For this a standard moisture resistant board was fixed to a stud layout suspended from the steel sub-frame. To seal the ceiling the joints were taped and filled, the whole surface was primed and a final finishing coat given - not unlike for example the finish to the walls of the Medway Hospital.

The key characteristic of the void above the ceiling was that it should maintain positive air pressure relative to the pool area below to minimise ingress of the corrosive vapours from the pool. Sealing and detailing of any perforations were therefore essential. Nevertheless special provision was made to protect any aspect more liable to corrosion for example priming cut ends of galvanised metal frame and fixings.

Another use of moisture resistant lining was for the toilet lobbies which were constructed in blockwork to which the linings were attached with specially selected moisture resistant dabs. Ceramic tiles were then fixed to these.

Another feature of the project is the use of dry lining to create curved features and bulkheads in the communal areas.

*Client:* PSA, for Inland Revenue

*Design and Build Contractor:* John Mowlem

*Architect:* Graham Brown Partnership

*Dry wall subcontractor:* Ray Smith Dry lining Ltd

The Gypsum Products Development Association (GPDA) comprises a permanent Secretariat and member companies, in the UK and the Republic of Ireland, all engaged in the manufacture of gypsum products. The primary function of the GPDA is to develop and encourage the understanding of gypsum-based building products and systems and to pioneer new applications for these products.

It also has an ongoing commitment to advise on matters of environmental impact, energy conservation and health and safety, wherever gypsum based products are used. The members promote the use of systems which maximise the conservation of energy and give a high priority to waste reduction and recycling initiatives.



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