IBS DIGEST

CIDB MALAYSIA

Go Modular

A quarterly promotional publication on industrialised building systems

January – March 2005

- Roadmap IBS 2003 – 2010
- Budget 2005: A Boon to the Success of IBS Implementation
- Manual of IBS Content Scoring System (IBS Score)
- CIDB-UKTI IBS Seminar "Innovation in Construction Through IBS – Malaysian and UK Perspectives"
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Cover: The Crystal Palace, Hyde Park, London

One of the earliest prefabricated and modularised building, it was constructed for the Great Exhibition in 1851. The standard-sized prefabricated (iron frame & glass panels) components allowed the building to be easily assembled on site; and without any massive foundation. Completed in only 9 months, it had a maximum height of 64ft; and length and width of 1,848ft and 408ft respectively. Based on a modular size of 24ft components, it allowed the structure to be easily dismantled and re-erected in Sydenham after the expo.

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Message from CIDB Chief Executive

I am proud to introduce IBS Digest as an official medium for the Malaysian construction industry to make a radical shift from the conventional mode of construction to one that is driven by advanced technology. The Industrialised Building Systems (IBS) have abundant benefits which industry members may capitalize to enhance their competitiveness.

CIDB is committed to disseminate information, educate, update and motivate industry players to embrace the usage of IBS. We believe this mode of construction is not to burden contractors with additional costs or a lengthy learning process, but in the long run, adoption of advanced technology would transform our local players to be globally competitive.

I once again call industry players to take the opportunity to share the knowledge presented in this publication, and hope it would help elevate our achievements to greater heights.

Dato' Ir Hamzah Hasan

Explore the Vast Access to IBS and Take Up the Challenge to Progress

Already utilized in Malaysia since 1960s, the Industrialised Building Systems (IBS) is the way forward for contractors to make leaps and bounds progress in the Malaysian construction industry. Sufficient exposure and incentives are pouring in to encourage industry players to make a paradigm move – from conventional to state-of-the art construction.

The birth of IBS Digest is another initiative of CIDB Malaysia and its industry partners to help industry members to acquire related information on IBS, understand its benefits, adopt suitable techniques and learn new issues to continuously keep abreast with new developments in IBS, both locally and internationally.

The maiden issue of IBS Digest shares with its readers, the IBS Roadmap 2003 2010; unveils the benefits of IBS, the various systems available for adoption, regulations and procedures to facilitate its adoption, and other miscellaneous issues. It is a good reference for every industry players to keep their construction technology adoption in the right track.

The many incentives provided to IBS adopters as outlined in the 2005 Budget, announced by the Prime Minister last year, is a boon for the success of IBS in Malaysia. Besides helping the Government to fulfill its social obligations in providing shelters for the low income population, the usage of IBS components exceeding 50 percent in Government buildings will qualify builders to get full exemption on levy imposed by CIDB.

To qualify for the incentives, builders will have to forward their degree of adoption precisely before the due benefits are rewarded to them. This will require a specific measure or score system which CIDB has prepared, in the form of a Manual; the IBS Content Scoring System (IBS SCORE). It provides a good guide to its users in evaluating their degree of compliance.

Precast Concrete Construction which involves the use of precast elements, even though is relatively new in Malaysia, has contributed significantly towards the development of the nation; especially in infrastructure and social development projects. The Pekeliling or Tuanku Abdul Rahman Flats; constructed in 1960s and the Putra-Star LRT and KL Monorail projects which began developments in 1990s are some of the comparative venture period of Malaysia's construction industry

Another superb cost saving system, the Tunnel Form System is a formwork system which builders may use to cast walls and slabs in one operation efficiently. Readers should not miss the opportunity to enrich their knowledge in IBS by participating in the coming CIDB-UKTI IBS Seminar, on 18 – 19 January 2005.

To improve the quality and contents of our future issues, IBS Digest welcome readers to send their comments, or article contributions which may benefit our industry. We also welcome advertisers of IBS related product and service providers to take the opportunity to introduce their offerings through IBS Digest.

Roadmap Industrialised Building Systems (IBS) 2003 – 2010

Dalam era globalisasi, tanpa teknologi dan pengalaman yang relevan serta masalah kualiti, produktiviti dan keselamatan yang membelenggu, para kontraktor tempatan menyebabkan mereka tidak dapat bersaing dengan kontraktor luar negara yang berpengalaman luas dalam pembinaan secara efektif, terutamanya mereka yang mengamalkan Sistem Binaan Berindustri (*IBS – Industrialised Building Systems*). IBS merupakan proses pembinaan yang menggunakan teknik, produk, komponen atau sistem pembinaan yang melibatkan prefabrication dan pemasangan komponen-komponen binaan di tapak pembinaan. Daripada klasifikasi berasaskan struktur, terdapat lima kumpulan utama IBS yang dikenalpasti digunapakai di negara ini iaitu:

Precast Concrete Framing, Panel and Box Systems
Precast column, beams, slabs, 3-D components (balkoni, tangga, tandas, ruang laluan lif), *permanent concrete formwork,* dan lain-lain;

Steel Formwork Systems
Tunnel forms, beams and column moulding forms, permanent steel formworks (metal decks), dan lain-lain.;

Steel Framing Systems
Steel beams and columns, portal frames, roof trusses, dan lain-lain;

Prefabricated Timber Framing Systems
Prefab timber frames, roof trusses, dan lain-lain; dan

Block Work Systems
Interlocking concrete masonry units (CMU), lightweight concrete blocks, dan lain-lain

Penggunaan IBS dalam pembinaan menjanjikan pelbagai kelebihan seperti pengurangan pekerja di tapak binaan, pengurangan pembaziran bahan binaan, pengurangan bahan binaan di tapak, pemeliharaan alam sekitar serta tapak binaan yang lebih bersih, kawalan kualiti yang lebih baik, tapak pembinaan yang lebih teratur dan selamat dan tempoh pembinaan yang lebih singkat. Kelebihan-kelebihan yang ditawarkan oleh penggunaan IBS dapat mengalihkan sektor pembinaan daripada masalah 3-D atau 3-K iaitu *Dirty* (*Kitanai*), *Difficult* (*Kitsui*) dan *Dangerous* (*Kiken*); yang selama ini merupakan antara punca pekerja tempatan hilang minat untuk memasuki sektor pembinaan. Ini seterusnya membawa kepada peningkatan daya membeli penduduk Malaysia dan membawa penambahbaikan dari segi ekonomi dan sosio-budaya. Rekod CIDB mendapati hampir tiga daripada empat pekerja asing yang memohon ujian kepakaran untuk lanjutan permit terdiri daripada mereka yang terlibat dalam tred basah (*wet-trades*) seperti penyusun batu-bata, tukang kayu (acuan), tukang besi, tukang lepa dan tukang konkrit. Dengan mengurangkan *wet-trades* melalui IBS, ia akan mengurangkan pergantungan kepada pekerja asing

dan negara dapat menjimatkan berbilion ringgit yang dibawa keluar oleh pekerja asing. Ia juga boleh membantu mengurangkan kebarangkalian masalah sosial yang mungkin timbul akibat kebanjiran pekerja asing.

CIDB telah mengusahakan penyediaan Roadmap IBS 2003 2010 sebagai dokumen blueprint untuk mengindustrikan sepenuhnya sektor pembinaan Malaysia. Kejayaan program ini akan menjuruskan industri ke arah pengurangan pergantungan kepada tenaga kerja tidak mahir, yang seterusnya akan mengurangkan bilangan pekerja asing dan peningkatan kualiti, produktiviti, keselamatan, dan daya saing dalam industri pembinaan. Penyediaan Roadmap ini bertujuan untuk dijadikan panduan dan rujukan kepada semua pihak; terutamanya dalam usaha melaksanakan aktiviti-aktiviti yang boleh mengarah kepada pengindustrian sektor pembinaan Malaysia. Ia dirangka berasaskan kepada galakan penggunaan Sistem Binaan Berindustri sebagai alternatif kepada cara pembinaan konvensional (in-situ). Roadmap ini mempunyai matlamat jangka panjang untuk mencapai Sistem Pembinaan Terbuka *(Open Building Systems, OBS)* dan pengindustrian sepenuhnya sektor pembinaan Malaysia menjelang tahun 2010.

Pelaksanaan Roadmap IBS dipandu, dipantau dan diselaraskan oleh sebuah jawatankuasa peringkat nasional yang dipanggil Jawatankuasa Pemandu IBS yang keahliannya mewakili semua sektor di dalam industri pembinaan bagi memastikan program IBS dijalankan dengan baik dan teratur. Kumpulan-kumpulan kerja untuk setiap kategori juga ditubuhkan untuk menggubal Roadmap tersebut dan juga memastikan supaya program yang dirancang dan disempurnakan menuju sasaran pengindustrian sepenuhnya sektor pembinaan Malaysia menjelang tahun 2010.

Antara strategi utama yang digariskan di dalam Roadmap IBS 2003 – 2010 adalah:

a. Mengurangkan peratusan tenaga buruh asing daripada jumlah pekerja binaan; terutamanya mereka yang terlibat dalam *wet trades* seperti tukang konkrit, tukang kayu (acuan), tukang besi dan tukang lepa.

b. Penguatkuasaan penggunaan Kordinasi Modular *(MC)* berdasarkan MS 1064 melalui Undang-undang Kecil Bangunan Seragam (UKBS) oleh Pihak Berkuasa Tempatan.

c. Penggunaan *IBS* untuk perumahan mampu milik.

d. Penguatkuasaan penggunaan IBS di dalam projek-projek (bangunan) kerajaan.

e. Penguatkuasaan Skor Minimum Kebolehbinaan (*Buildability*) untuk projek bangunan (swasta) melalui penguatkuasaan PBT.

f. Penggunaan komponen IBS yang disahkan sahaja (berasaskan standard komponen *IBS*).

g. Insentif pengurangan levi yang dikutip oleh CIDB bagi penggunaan MC.

h. Program kelulusan pelan bangunan secara *green-lane* untuk pengguna pelan standard yang direka mengikut MC dan komponen binaan piawai.

i. Skim latihan dan pinjaman kewangan untuk melahirkan pengeluar komponen dan pemasang IBS Bumiputera.

The Danish trail for IBS implementation

M. R. Abdul Kadir[1], Mohd Yusuf Sulaiman[2] and Sumarni Ismail[3]

The Impulse

The devastation brought by the World War II has brought with it a new experiment within the construction industry in Denmark. The colossal lost in terms of material and human resources gave rise to the impetus to see alternative means of doing things so as to satisfy immediate huge demand from the construction industry: notably the housing segment. The demand driven industry (then) and limited time to accomplish the task necessitate a single minded intervention from the government has been reciprocated by an equally vigorous response from the industry: thus, the transformation.

Lack of building materials and skilled workers obliged the governmental economical support through a new law where new material or innovative construction methods were to be used. The Ministry of Housing was founded and complimented by a governmental Institute of Building research. These factors provided the political focus, centered on the so-called 'non-traditional building'

Done

A definite conviction among the different parties within the building sector to collaborate and try out new directions displayed tests and experiments rather than conscious, coordinated development. The industrial production apparatus rather than the architect's vision which dictated building activities. The desire for experimentation resulted in projects with a more free spirit. Terraces were added to the blocks, the repetition in the facades included variation, and the plans showed new examples of spatial organization. An acute lack of housing, building materials and of skilled labour created a situation within society which exerted decisive pressure on the building sector.

Basic concepts

The planning is made on the basis of the concept of modularization. The feature of repetition is used as much as possible: through the use of similar (standardized and typified) building parts. The new building methods became well known and the details were fully developed with a very high technical specification.

Being industrialized, new businesses & world view formed

The establishment of a great number of new companies producing building components, increase the international awareness of the achievements in the Danish building sector and landed with a huge export of know-how and systems. Projects could out source different / the same components from different factories, yet compatibility was not an issue. The coordinated modularization had impacted the industry the likes of our present industrialized products which is taken for granted by consumers. The Danish industrialization in the 1960's had been successful: measuring the amount of new housing units and their high technical standard.

The third wave industrialization

Locking itself into a 'new industrialization' based upon information technology and advanced production technology, it is no longer the number game and to build soundly. Industrialised housing fulfills the demands and needs of the user and demonstrates value and quality concurrently. Through Virtual Reality, designs could be walked through and, components and subsystem for the housing unit could be assembled in digitized form to negotiate clashes in terms of design, construction and final usage by customer: hence buildability / constructability addressed off-site.

Montage versus repetition

The current tools of information technology & the production system can handle individual solutions within one production process. It is no longer the product which is standardized but only the process. This adds new dimension to the concept of standardization and challenges the notion of prefabrication.

Le Corbusier anticipated, almost a century ago, the ability of architects to extent their creativity within the repetitive production of form that expresses another dimension of aesthetics. Thus, it is no more repetition; rather it is montage through the current technology. It was stated that the intellectual heritage of Le Corbusier was forgotten when the mass house production started. The rediscovery of his works is an act of redemption for the architectural freedom provided by technology and industry

Finale

The trails gave a new vigor in pursuant for the IBS agenda. Quality, diversity and productivity are seen as a possibility through the rediscovery of Le Corbusier's work.

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Introduction To The IBS Content Scoring System (IBS SCORE) Manual

INTRODUCTION

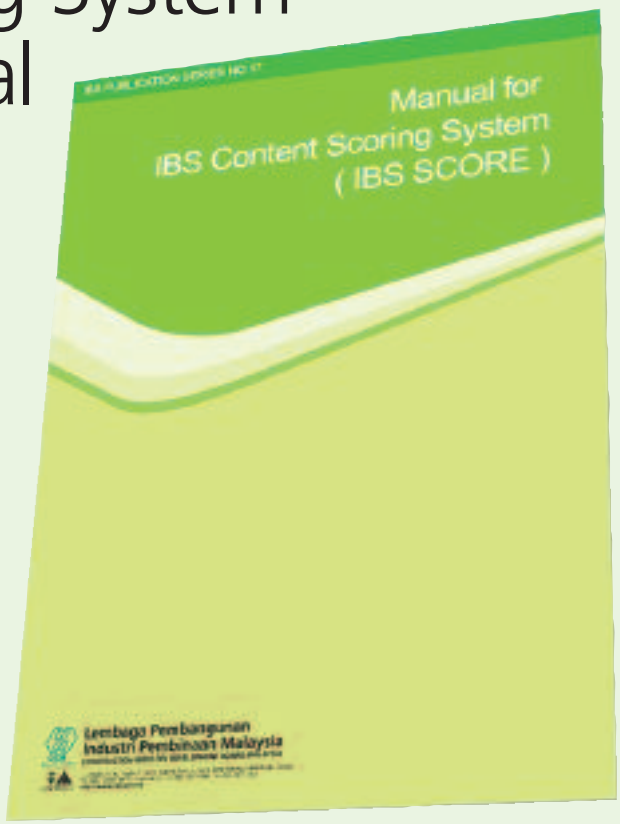
Prosperity and high economic growth in Malaysia has created a high demand for construction activities. As a consequence, this has attracted huge number of foreign workers into the country to take up employment on site as unskilled labours, doing manual jobs. Despite their contributions, the country is in a quagmire with a host of problems such low quality works, delays, wastages, social problems, diseases, etc.

IBS ROAD MAP

It is the right time now for some form of government intervention. Industrialisation of the construction industry is seen as the only feasible way forward. As such, the government has laid out a comprehensive national IBS Road Map for the construction industry players to adopt in the industrialisation programme of the construction industry. Essentially, the Road Map evolves on the policy of phased reduction of dependency on foreign labours and encouragement policy on investment in technologies, techniques and processes of construction. It laid out definite action plans which when successfully implemented, shall ensure a successful upgrading of our construction industry.

As a push for utilisation of Industrialised Building Systems, a number of encouragements and regulatory requirements have been put forward. An example of such regulatory requirement is 'minimum percentage of utilisation of IBS in government building projects'. Likewise, minimum percentage requirement is also needed for CIDB Levy exemptions. Consequently, some form of IBS content assessment is needed for the purpose.

The IBS Content Scoring System (IBS Score) is a systematic and structured assessment system that can be used to measure the usage of Industrialised Building Systems (IBS) in a consistent way.



THE IBS SCORE MANUAL

The objective of this Manual is to provide a well-structured assessment system for the IBS Score. It sets out the IBS Score Formula, the IBS Factor for each of the elements used in the building, methods of calculating the IBS Score, explanatory notes as well as sample calculations. It is also intended to provide a complete guidance for every professional to evaluate the IBS Score for any building project.

PRINCIPLES OF IBS SCORE

The IBS Scoring System emphasizes on the following attributes: -

1. the use of prefabricated and precast components
2. off-site production of components
3. the use standardized components

4. repeatability
5. design using Modular Coordination concept

Higher IBS score is a reflection of a more reduction of site labour, lower wastage, less site materials, cleaner environment, better quality, neater and safer construction sites, faster project completion as well as lower total construction costs.

The method of determining the IBS Score is designed to be a simple but effective process. Points are awarded based on the IBS Factors of the structural and wall elements used. The presence of high repetitiveness in the design as well as other simplified construction solutions shall also contribute to the total score. The points are summed-up to give the IBS Score of the building. IBS Score for the whole project development that consists of a group of buildings is also provided.

THE IBS CONTENT SCORING SYSTEM

i) The maximum IBS Score for a building is 100 points.

ii) The IBS Score is made up of the following components:

Part 1 – Structural Systems (Maximum score is 50 points)

Points are awarded for various types of structural system used,

e.g. precast concrete beams and columns, steel, prefabricated timber, etc.

Part 2 – Wall Systems (Maximum score is 30 points)

Points are awarded based on various types of wall systems used

e.g. precast concrete panel, glass, dry partition, block work, etc.

Part 3 – Other Simplified Construction Solutions (Maximum score is 20 points)

Points are awarded based on usage of other simplified construction solutions

e.g. standard components based on MS 1064, standardised grids, other 3D prefabricated components such as prefabricated toilets, staircases, etc.

iii) The formula

IBS SCORE = SCORE FOR STRUCTURAL SYSTEMS
+
SCORE FOR WALL SYSTEMS
+
SCORE FOR OTHER SIMPLIFIED CONSTRUCTION SOLUTIONS

$$50\sum\left[\frac{Q_{ST}}{Q_{ST}}F_S\right]+30\sum\left[\frac{Q_W}{Q_{WT}}F_W\right]+S$$

Where:

Q_S - Floor area of structural system

Q_{ST} - Total floor area of building

F_S - IBS Factor for structural system from Manual's Table 1

Q_W - Length of wall system (external or internal)

Q_{WT} - Total wall length (external and internal)

F_W - IBS Factor for wall system from Manual's Table 2

S - IBS Score for other simplified customer solutions from Manual's Table 3

iv) IBS score calculations consider superstructure only.

v) In the case of a group of buildings in one project, the IBS Score of the project shall be calculated by multiplying the percentage of area of the respective building (out of total area of project); with the IBS Score of the individual building.

$$\sum\left[\text{IBS SCORE FOR BUILDING}\times\frac{Q_{ST\,(building)}}{Q_{ST\,(project)}}\right]$$

Please contact CIDB's Technology Development Division at tech@cidb.gov.my for more details.
Full version of IBS Score Manual is available for download at www.cidb.gov.my

BUDGET SPEECH 2005

A Boon to the Success of IBS Implementation

"The Government is determined to ensure that every Malaysian will have access to affordable homes. During the period 1971-2003, the Government constructed 490,000 units of low-cost houses while the private sector constructed 509,000 units for low-income families. The Government intends to provide ***an additional 100,000 units of affordable homes to be implemented through the Industrialised Building System (IBS).*** *This system will ensure quality construction, save cost, create a safer and cleaner working environment as well as reduce the dependence on foreign workers. The usage of IBS components in Government building projects* ***will be increased from 30 percent currently to 50 percent commencing 2005.*** *Housing developers who* ***utilise IBS components exceeding 50 percent, will be given full exemption on levy*** *imposed by CIDB"*

Excerpts from The 2005 Budget Speech by
YAB Dato' Seri Abdullah bin Hj. Ahmad Badawi
Prime Minister and Minister of Finance Malaysia

Precast Concrete Construction

Introduction

Besides steel and prefabricated timber frames, precast concrete components are among the most common Industrialised Building Systems (IBS) or prefabricated elements that are available in the construction industry, both locally and abroad. Basically, precast concrete elements are concrete products that are manufactured and cured in a plant environment and then transported to a job site for installation.

The Range of Products

Precast components come in a variety of shapes for different types of usage, both architectural and structural. It includes the traditional precast beams, columns, slabs, walls, staircases, parapets and drains; as well as other relatively new precast components for toilets, pilecaps, facades, lift shafts and refuse chambers. Also common are the precast concrete permanent formworks that consist of precast panels that act as forms for in-situ concrete. It includes the "Half Slabs" and the "Sandwiched/Double Walls". As the production of lightweight concrete are getting cheaper, more precast components are also produced in the form of lightweight concrete panels and blocks that greatly ease transportation and installation. The traditional time-consuming site bar-bending, formwork, concreting and brick-laying trades are replaced by the usage of these effective alternative solutions.

History

The usage of precast elements in construction is not new, particularly in the United States where steel beams and columns are often combined with precast slab panels in rapid construction of skyscrapers. However, its usage in the Malaysian construction industry is relatively new. Precast concrete buildings were introduced in Malaysia in 1966

when the government launched two pilot projects for precast houses. The construction of Tuanku Abdul Rahman Flats in Kuala Lumpur and the Rifle Range Road Flats in Penang were the first time that precast concrete elements were used to construct mass houses. Later, Perbadanan Kemajuan Negeri Selangor (PKNS) brought technology from Germany for the construction of numerous housing projects, ranging from low cost houses to high cost bungalows. Private companies have also teamed up with foreign experts in precast technology, especially from Australia, Holland, United States and Japan, to offer precast solutions for their projects.

Since then, numerous construction projects in Malaysia have utilised precast components, especially when the requirement is to build quickly and with high accuracy and quality. Precast components are used in a number of rapid constructions of, among many others, schools, colleges, quarters, apartments, hospitals as well as road, rail, port and drain infrastructures.

However, even after four decades of introduction, the usage of precast products in the Malaysian construction industry is still relatively very low if compared to developed economies such as Japan, United States and Europe. The industry chooses to ignore the benefits of precast construction and still opt for the conventional methods while risking quality, productivity and safety.

Benefits of Precast Concrete

Most of the industry players fail to realise that precast concrete offer better alternative to the traditional and labour intensive in-situ construction. The main benefits offered by the usage of precast elements are:

i) **High quality and aesthetical value of products**
Precast products are manufactured in a casting area where critical factors including temperature, mix design and stripping time can be closely checked and controlled; and this will ensure that the quality of precast products are better than cast-in-situ concrete. A huge sum of money will be saved by not having to do rectification works. Also due to factory-controlled prefabrication environment, many combinations of colours and textures can be applied easily to the architectural or structural pieces. A vast range of sizes and shapes of precast components can be produced, providing a great deal of flexibility and offer fresher looks to the structures.

ii) **Cleaner and safer construction sites**
Usage of precast elements eliminates or greatly reduces conventional formworks and props. Precast construction also lessens the problem of site wastages and the related environmental problems. The prefabricated products also provide a safe working platform for workers to work on. Workers and materials are also greatly reduced at the



construction sites. Using Just-in-Time principles, the precast elements are kept at the factory yard until the site is ready for installation. Also, as elements are produced in the plant and mostly designed to be repetitive, minimal wastage will be experienced at both factory and construction sites.

iii) **Faster construction**

Precast concrete construction will save valuable time and helps to reduce the risk of project delay and possible monetary losses. Precast design and production of elements can be started while the construction site is under survey or earthworks. Production are also unaffected by weather conditions due to the controlled environment of the casting area. Also, the usage of large precast panels will reduce the time taken to complete the structural works. Therefore, other trades such as painting and electrical wiring can begin work sooner.

iv) **Greater unobstructed span**

The usage of prestressed precast solutions such as the Hollow Core slabs and Double-T beams offer greater unobstructed span than the conventional reinforced concrete elements. Having lesser beams and columns, will provide larger open space. It is very ideal for the construction of places of worship, warehouses, halls, car parks, shops and offices.

v) **Lower total construction costs**

All of the above simplify the construction processes and increase productivity, quality and safety. As a result, the total costs of construction are reduced.

More often than not, most of the opponents of precast construction only use the costs of materials in comparing the in-situ and precast construction without realising that there are hidden costs to the traditional methods. Also a contributing factor to the low usage is the fact that Malaysia has always been able to source cheap labours from neighbouring countries. Therefore, the industry players are very reluctant to change to the new construction methods. As a result, the country is faced by problems of low quality, productivity and safety in the construction industry due to high dependency of manual

labour. The country also suffers from the outflow of monies as well as social problems. If the labour supply experience sudden reduction while demand remains the same, labour costs will definitely be increased and produce more problems to the industry.

Better Future

The failure of early precast systems introduced in Malaysia is another contributing factor that forced the industry maintain in-situ construction. Undoubtedly, some of the early Western systems were not suitable to be used in the Malaysian climate. Cracks and leakages were common at the joint area. Shoddy installations had also contributed to these problems. However, it must be stressed here that those were problems of the past decades and precast technology has since improved. Joints and sealants have been designed for usage in the Malaysian climate. The local installers are also more familiar with the precast technology and able to perform complex installation procedures. There are now quite a number of manufacturers of precast concrete products and installation accessories in Malaysia. The factories are located all over Malaysia, thus reducing the transportation costs, which is very crucial for the viability of precast construction. With this and the increased number of product range, the customers can expect better deals; and

it makes precast construction more attractive. Nevertheless, while the utilisation of precast components is still low in the building segment, the usage in local infrastructure projects is much higher. Instead of in-situ construction, precast concrete box girders, beams, parapets, railway sleepers, culverts and drains have been chosen as the better alternative for the execution of infrastructure projects. The construction of Putra/Star LRT and Monorail in Kuala Lumpur as well as tunnels, elevated highways and bridges all over Malaysia have greatly utilised precast components.

Government Initiatives

The Malaysian Government is also currently very active in promoting the usage of prefabricated materials, particularly precast components. The Public Works Department (JKR), Construction Industry Development Board (CIDB) as well as the Ministry of Housing and Local Government are among the leaders in championing its usage in the construction industry. JKR have also produced a new set of drawings utilising precast components for its standard quarters. More hostels, schools, colleges and low cost houses are also now being designed and constructed using precast elements. It is hoped that more clients, designers and contractors in the local construction industry heed to government's call for the industrialisation of the construction sector and opt for precast construction as an alternative to the in-situ method. The commitment and cooperation between the government and private sector are crucial in ensuring the success of the program. In order to survive in the era of globalisation, it is important for local players to change their perception and begin to use new techniques to produce better quality, productivity and safety in construction.

Tunnel Form Solutions

Introduction

Tunnel Form is a formwork system that allows the contractor to cast walls and slabs in one operation on a daily cycle. It can be reused more than 500 times which results in higher productivity, efficiency, economy and quality. The usage of Tunnel Form System has now become a trend in the Malaysian construction industry, especially for high rise buildings.

The System's Benefits

Recognised as one of the Industrialised Building Systems (IBS), Tunnel Form simplifies the whole construction process by enabling a smooth and fast operation that can result in cost effectiveness, productivity and high quality finished. Tunnel Form projects have proven that impressive results can be achieved in terms of productivity, efficiency, economy and quality. It can usually be reused for 500 to 1,000 times, and is an effective way to construct buildings that have repetitive elements or layouts. The system is now one of the most preferred methods of cellular construction by the contractors in Malaysia whilst clients appreciate Tunnel Form's ability to deliver projects to budget and on time. Costs value engineering starts with the early involvement of the formwork supplier. The formwork is available to the contractor for purchase or rent and can be reused on other projects.

Construction Process

During the construction process, Tunnel Form allows the contractor to cast walls and slabs in one operation on a daily cycle. Each 24 hours, the formwork is moved so that another tunnel can be formed. The walls and slabs are cast in a single operation using specially designed half tunnel-steel forms (upside down U shape) that maintains a certain size. This cuts down the construction time significantly. The wall and the slab form a monolithic joint. The following construction sequence is implemented:-

1) The Tunnel Forms are first cleaned and coated with form oil. They are then placed in their positions by using the kicker as the guide.

2) The wall reinforcement leads the tunnel formwork. Reinforcement steel and electric conduits are positioned on the tunnel form.

3) Walls, slabs and kickers are cast together. In accordance with the design, steel block outs may be installed on the formwork panels to form the plumbing openings.

This process is repeated on the next floor. A strong, monolithic structure is thus constructed that can reach 20 or more storey in height. Tunnel Form creates cells which

are 2.4 to 6.6m wide. These can be easily subdivided to create smaller rooms. Where longer spans (up to 11m) are required, the Tunnel Form can be extended using a mid-span section. The result is a cellular reinforced concrete structure, the surfaces of which are of sufficiently high quality to require only minimal finishing for direct decoration, while the end walls and façades are easily completed with thermally insulated units that can be cladded as required.The system creates an efficient load-bearing structure for use in a wide variety of applications. It is particularly effective in projects suited to repetitive cellular construction such as residential blocks, hotels, hostels and prisons.

The techniques used for Tunnel Form only need a team of nine site operatives plus a crane operator; can strike and fix some 300m^2 of formwork each day, including placing 35m^3 of ready-mixed concrete: typically 2.5 cells. In addition to speed of construction, the technique provides further inherent benefits of concrete: high levels of thermal mass, sound insulation and fire resistance. The schedule provided by the 24-hour cycle means each operative knows exactly what to do and when, and works to a precisely detailed plan. The smaller work teams and predictable, measurable daily production rates simplify and enhance overall control of the project. Known completion times make scheduling of material deliveries and follow-on trades more accurate and optimise cash flow by facilitating 'just in time' principles. By quickly providing protection, the system allows the following trades to commence work on completed rooms while work proceeds on upper floors.

Safety

Tunnel Form has integral working platforms and edge protection systems. In addition, the repetitive, predictable nature of the tasks involved encourages familiarity with operations and, once training is complete, productivity improves as construction progresses. The minimal requirement for tools and equipment when moving the

Tunnel Form further reduces the risk of accidents on site. Comprehensive method statements from the formwork suppliers and a full safety risk assessment enhance safety in Tunnel Form's application. Normally, the Tunnel Form suppliers provide design and technical support to ensure that engineers, architects and contractors are all familiar with the system and its application as the project starts; enabling time and cost savings to be achieved. If the contractor is inexperienced with Tunnel Form System, the supplier's site training would quickly help bring them up to speed. Tunnel Form provides a winning combination of the speed, quality and accuracy of factory production with the flexibility and economy of in-situ construction.

Conclusions

Tunnel Form construction can provide:

- Substantial savings in costs
- Substantial savings in labour
- Much faster construction
- Enhanced safety
- Better management control
- Predictable work flow
- Quicker return on investment
- Precise, high quality structures
- Design flexibility

References

- The Concrete Centre, High Performing Buildings Using Tunnel Forms Concrete Construction, 2004
- Symons Room Tunnel Systems, 2004

CIDB-UKTI IBS Seminar 2005

18 – 19 January 2005

United Kingdom and Malaysia share an economic tradition and trading ties that stretch over two hundred years. UK is still one of Malaysia's top trading partners and with this background, it is necessary to look ahead for avenues and channels to reinforce this relationship for the good of both countries. With the rapid evolving landscape of the world's economy that is being driven by new ideas and perceptions, the importance of such cooperation has become even greater.

Similarly to Malaysia, there is a strong movement towards offsite construction in the UK. The UK government has a similar agenda in developing its construction sector towards global competitiveness through IBS or offsite construction. As such, the Construction Industry Development Board of Malaysia (CIDB) and the United Kingdom Trade Investment (UKTI) will organize the CIDB-UKTI IBS Seminar 2005, with the theme, "Innovation in Construction Through IBS – Malaysia and UK Perspectives" from 18 to 19th. January 2005. The event is co-organized by the British High Commission and the Loughborough University/Co-Construct's programme, *promoting Off-Site Production applications (PrOSPa).*

The Y.B. Minister of Works, Dato Seri S. Samy Vellu has been invited to officiate the event. A total of 13 papers have been scheduled to be presented and discussed. Topics to be discussed will include issues on the Malaysian and UK governments' policies, and designers, developers, contractors and manufacturers perspectives. More than 200 participants are expected to attend the event. The event plans to achieve its objective of promoting the use of new and innovative technologies in the construction industry by sharing knowledge and experience on the usage of IBS technology in both countries. It also plans to develop a network of Malaysian and UK experts on IBS for future cooperation and exchanges to benefit both countries.

IBS CALENDAR OF EVENTS 2005

EVENTS	ORGANISERS	VENUES	DATES
CIDB-UKTI IBS Seminar 2005 "Innovation in Construction Through IBS – Malaysia and UK Perspectives" • Seminar • Mini-Exhibition by UK and Malaysian IBS manufacturers	CIDB-UKTI	Kuala Lumpur	18 – 19 January 2005
IBS Roadshow Eastern Region • Seminar • Modular Coordination Training • Precast Concrete Design Training • Mini-Exhibition by local IBS manufacturers	CIDB	Kuala Terengganu	22 – 24 February 2005
MSSA-CIDB Convention and Exhibition 2005 "IBS: Synergy Between Steel and Component-based Construction"	MSSA & CIDB	Petaling Jaya	(actual date to be confirmed)
IBS Roadshow Sarawak • Seminar Modular Coordination Training Precast Concrete Design Training • Mini-Exhibition by local IBS manufacturers	CIDB	Kuching	June 2005 (actual date to be confirmed)
IBS Roadshow Sabah • Seminar • Modular Coordination Training • Precast Concrete Design Training • Mini-Exhibition by local IBS manufacturers	CIDB	Kota Kinabalu	June 2005 (actual date to be confirmed)

BIL	TITLE	DATE PUBLISHED	PRICE UNIT (RM)
1	CIS 1: 1998 (Standard Perumahan Kebangsaan Bagi Perumahan Kos Rendah 1 & 2 Tingkat)	1998	18.00
2	CIS 2: 1998 (Standard Perumahan Kebangsaan Bagi Perumahan Kos Rendah Rumah Pangsa)	1998	18.00
3	Modular Design Guide: 3rd edition	2000	20.00
4	Industrialised Building Systems (IBS) Roadmap 2003 – 2010	2003	Distributed Free of Charge
5	Manual for Assessment for Industrialised Building Systems	2001	Superceded and Withdrawn
6	IBS Survey 2003	2003	Distributed Free of Charge
7	IBS Strategic Plan	2001	Superceded and Withdrawn
8	Nota MC: Joints and Tolerance for Building Construction	2001	5.00
9	Nota MC: Implikasi Kordinasi Modular dalam Undang-undang dan Peraturan Bangunan	2001	5.00
10	Nota MC: Perlaksanaan Kordinasi Modular di dalam Industri Pembinaan	2001	5.00
11	Nota MC: Design Concepts Using Components & Buildability	2001	5.00
12	Catalogue of Metal Frame and Metal Formwork for Building Works 2004/2005	2004	10.00
13	Catalogue of Prefabricated Timber Components for Building Works 2004/2005	2004	10.00
14	Catalogue of Precast Concrete Components for Building Works 2004/2005	2004	10.00
15	Catalogue of Precast Concrete Components for Infrastructure Works 2004/2005	2004	10.00
16	Sizing Guide for Precast Concrete Building Components	2004	10.00
17	Manual for IBS Content Scoring System (IBS Score)	2005	10.00
18	CIS 5: 2004 Quality Assurance for Prefabricated Timber Truss Systems	2004	10.00
19	Proceedings of the International Conference on Industrialised Building Systems (IBS 2003): Global Trends in Research, Development and Construction	2003	50.00
20	IBS Reference Materials (softcopy, in CD)	2005	To be announced

CIDB Publications