

CAMBRIA

Constructive Thinking

Company Profile 2017

Welcome to the Cambria 2017 Profile

We are Consulting Civil and Structural Engineers who provide comprehensive services to the construction industry. We deliver the right civil and structural solution for all our projects, are commercially astute and aim to always exceed our Client expectations.

2016 has been a fantastic year for **CAMBRIA**. We have completed some incredible projects and were also delighted to have won the Construction Excellence in Wales – SME of the Year 2016. We are incredibly proud of this achievement and industry recognition. We dedicate this award to our loyal clients and committed team of staff – who are all outstanding and responsible for our success.

We really believe that it is our staff that make us what we are. Winning this award inspires us to maintain our regional reputation as **CAMBRIA** being the best place to work.



**ADEILADU
ARBENIGRWYDD
YNG NIGHYMRU**  **CONSTRUCTING
EXCELLENCE
IN WALES**
Gwobrau 2016 Enillydd Awards 2016 Winner

Red Hyperlinks are active within pdf version. If this is a paper copy, please visit www.cambria.co.uk to review with links.

Why Constructive Thinking?

CAMBRIA staff take immense pride in being part of design teams that are consistently delivering award winning projects and we believe that we play a pivotal role in helping that happen. Our Directors and Engineers challenge themselves in all our projects to find new innovative ways to improve the design, reduce the risks and find extra value for the client.

To make this happen we need some key ingredients:

- Highest quality MStructE engineers
- Empathetic understanding of Architectural and MEP requirements
- Open minded approach
- Staff training and CPD programme to ensure innovative awareness

CAMBRIA are a consultancy that are evolving and redefining the Consulting Engineers' role to be more explanatory, proactive and responsive. A service our **existing clients will testify** to.

CAMBRIA

Constructive Thinking

Contents

About us

1. Who we are
2. Professional Memberships and Accreditations
3. What we do
4. Sectors

Our Services

5. Preplanning Services
6. Structural Engineering
7. Infrastructure

Our Experience

8. 2017 Projects
9. Client Testimonials

Reference

10. Concrete vs Steel Construction
11. BIM

About Us

CAMBRIA

Constructive Thinking

1. Who We Are



Gary Mitchell

Director

T: 029 2009 3333

M: 07811 110888

E: g.mitchell@cambria.co.uk



Wynn James

Director

T: 029 2009 3333

M: 07854 584977

E: w.james@cambria.co.uk



Mark Gould

Director

T: 0117 911 3333

M: 07908 551530

E: m.gould@cambria.co.uk

2.1 Professional Memberships



CAMBRIA

Constructive Thinking

2.2 Company Accreditations



BUDDSODDWYR | INVESTORS
MEWN POBL | IN PEOPLE



Gwobrau 2016 Enillydd

Awards 2016 Winner

SME OF THE YEAR 2016

3. What We Do

Our services can be broadly divided into three distinct areas, corresponding with the usual UK construction process for most kinds of development.

(1) Pre-Planning

Cambria actively encourages early consultant involvement and our pre-planning advice can range from an informal view on likely acceptability of a new highway access, a formal due diligence report on engineering viability, or right through to full pre-planning services including the provision of Phase I Environmental Assessment, Flood Consequence/Risk Assessment, **Surface Water Drainage Strategy**, Transport Impact Assessment and Travel Plan.

(2) Pre-Construction

It is often the case that our clients have already progressed to outline planning or independently developed their site location. In our Pre-Construction phase, our services concentrate on the discharging of planning conditions, preparation of **Civil / Structural / Environmental / Highways** tendering information, design development and contractor tender evaluation.

(3) Construction

It is imperative that our design information is clear, concise and easily translated and delivered by the contractor. The Construction period is the critical time, where our reaction to unforeseen changes or site parameters can be the difference between a successful project and not. Whilst this period typically sees the least amount of information production, it is the time when we provide the highest levels of support.

Our expertise is in a wide range of project sectors including:

- Education – Primary and Secondary Schools, Colleges and Universities.
- Residential – Single and Multi storey developments involving social housing, student accommodation, Care Homes and private developers.
- Retail – food and non food retail stores, shopping centres and retail parks.
- **Offices** – single and multi-storey blocks for single and multiple occupation.
- **Public Buildings** – Libraries, Cattle Markets, Fire Stations, Life Boat Stations, HQ Offices.
- Healthcare – Hospital Alterations and Extensions, GP Surgeries, Pharmacies.
- Defence – Stores, Training and Recreation Facilities, Medical and Motor Transport Facilities.

4. Sectors

Commercial

We have a particular expertise in delivering developments for private developers where the key issues are to be on time and within budget to help Clients maximise their profit margin. We have successfully delivered the widest range of projects from entire Business Parks to individual developments.

Residential

Most of our projects involve residential developments for private and public sector clients who are looking to develop their sites as economically as possible either to maximise their gain or to simply be able to deliver new housing stock within their available budget.

Defence

Our Engineers have worked extensively on Defence related projects on Establishments throughout the UK and also on overseas bases such as Gibraltar and The Falklands. We therefore have a thorough knowledge of the MoD's project execution requirements particularly those relating to their JSP Scales, CTM, DREEM and approach to Risk Management.

Education

We have rightly developed a reputation for our breadth and depth of experience within the education sector . We have worked on ALN/SEN, Nursery, Reception, KS1 and KS2, Learning Plazas, Secondary, Further Education, Higher Education, Colleges and Universities. Our teams have worked on the first Primary School to achieve BREEAM Excellent and also the first Secondary School in the UK to achieve BREEAM Outstanding.

Health

We consider our Healthcare experience to be a particular advantage with our engineers and technicians having successfully completed a wide range of healthcare related projects throughout the UK for both private and public sector clients including NHS Trusts.

Retail

Our Retail clients benefit from our commercially astute approach to project delivery which is of particular advantage where there are store opening dates which cannot be missed.

Our Services

5. Preplanning Services

5.1 Phase 1 Environmental Assessments

Many projects involve sites which have been subject to various previous uses that could have contaminated the ground. We aim to keep the costs of testing for contamination to a minimum by providing our clients with a Phase 1 Environmental desk study which involves:

- Examining historic and geological mapping records and documentation.
- Establishing the previous, potentially contaminative, uses of the site.
- Establishing the potentially contaminative uses of surrounding land.
- Identify the contaminants (sources) potentially associated with these uses.
- Identify the environmental receptors potentially at risk from identified contaminants.
- Establish the potential physical pathways linking potential sources and receptors.
- Highlight factors influencing source-pathway receptor linkages.
- Compare threshold levels for remedial actions.
- Provide a specification for the Phase 2 intrusive site investigation works.
- Provide an appraisal of potential remedial options within a comprehensive report.

5.2 Transport

We provide our clients with the required **Transport Assessment** and **Travel Plan** reports in support of their Planning Applications and then follow through with the design and detailing of the required highway works.

Our Engineers have successfully delivered Transport Assessments and Travel Plans for Clients wishing to secure Planning Approval on projects throughout the country. These projects mean we are expert in:

- Traffic modelling of Local Highway Networks.
- Delivering **Transport Assessment** reports to Local Highway Authority/Highway Agency/TfL Approvals.
- Securing approvals to cost effective **Travel Plans**.
- Providing **Bus Stop Audits** when requested in support of Planning Applications.
- Attending public planning inquiries and appeals.
- Providing expert witness reports and advice.

5.3 Flooding

Our Flood Risk Screening work establishes the extent of the work necessary to satisfy the Environment Agency (EA/ Natural Resources Wales (NRW) and the Local Planning Authority's (LPA) requirements and involves the following:

- Contacting and liaising with the EA/NRW to obtain any Flood Risk information it has for the site and immediate vicinity and establish its specific Flood Risk Management requirements.
- Establishing (in consultation with the LPA and the EA/ NRW) the design lifetime of the proposed development and the proposed standards for flood defence and safety.
- Researching publicly available relevant documents such as Catchment Flood Management Plans, Regional Flood Risk Appraisal, Preliminary Flood Risk Assessments, etc.
- Contact the local Water Authority to obtain information on the capacity of their existing sewer network in the vicinity of the site, as well as identifying any known problems they may have with their network.
- Establish current local planning authority policies in relation to flood protection, surface water drainage, sustainable drainage and protection/recharge of groundwater (including any strategic flood risk assessments (SFRAs) or precursor documentation which may have been prepared).

6. Structural Engineering

Why do you need us?

We can deliver a building that you can be proud of – Architecturally and Structurally and easy to construct. We are passionate about minimising construction costs and will exceed whatever is expected of us.

All projects are individual and we will have your best interest as our top priority. In order to achieve this we will:

- Design a range of potential superstructure options to deliver the best solution.
- Design to a Cost Code not just the Structural Engineering Code.
- Ask questions and test decisions to improve on what's being delivered.
- Propose alternatives whenever we can to reduce costs but not compromise on quality.
- Examine documentary geological and borehole records for groundwater depths and quality data.
- Establish which are the sources as well as the potential sources of flood risk.
- Having undertaken the above work we will have defined the required scope of works to be covered within the FCA/ FRA Report to be submitted in support of the Planning Application.

When do you need us?

Developers, Local Authority, House Builders, Estate Managers - If you wish to build something then you need to contact us as soon as you have decided to go ahead.

Contractors - As soon as you have decided to tender for a contract to construct a building of any kind contact us – preferably before the tender comes out to give us as much time as possible to help you win it.

Our expertise in delivering our structural engineering services:

Our Engineers have extensive experience of delivering structural engineering related projects for Clients throughout the country and overseas. These projects mean we are expert in:

- Structural modelling and 3D analysis of common and complex structures. **BIM** modelling and clash detection – Revit, Navisworks.
- Alterations and extensions to traditional and system build buildings.
- Works to listed buildings and ancient monuments.
- Securing environmental credits for BREEAM, Code for Sustainable Homes, CeCEQUAL, etc
- Delivering Structural solutions to Clients with problem buildings.

7. Infrastructure

In the last two decades the construction industry has reacted to the Egan and Latham reports and, by consensus, achieved a degree of success in delivering off-site, higher quality and low risk building solutions. However, the processes regarding delivering the site were somewhat neglected. The engineering approach to the site and manner in which we decide to prepare the site for development through the various facets of Civil Engineering will have the greatest influence on risk, cost and the local environment.

Why do you need us?

One of the greatest risks in delivering a development project to a budget involves the Civil Engineering design of the works. Abnormal groundwork costs frequently arise but they can often be off-set with clever and often innovative design solutions such as:

Avoiding the need to clean up **contaminated ground** beneath brownfield sites.

Improving the quality of poor ground to avoid the need for costly piling.

Designing **ground levels** to avoid the need for costly import or export of bulk materials.

Designing clever surface water drainage solutions (**SUDS**) to help avoid the need for costly attenuation and still secure the Environments Agency's approval.

Creating foul **drainage** capacity in combined sewers to allow new developments to be connected to them at minimum cost.

When do you need us?

Developers - If you have found a site and wish to develop it then you need to involve us straight away.

Contractors - As soon as you have decided to tender for a contract to construct a building of any kind contact us – preferably before the tender comes out to give us as much time as possible to help you win it.

In all cases the sooner you speak to us the sooner we can identify the Civil Engineering cost risks to your project and the sooner we can lessen them with sustainable solutions which will reduce construction costs.

Our Experience

8. 2017 Projects

Croesyceiliog Secondary School, Torfaen



Client:	Torfaen County Borough Council	
Contractor:	Kier Construction	
Architect:	Stride Treglown	
Sector:	Education	
Value:	£32m	Completion Date: 2019
BREEAM:	Excellent	

Cambria Consulting are appointed as Civil and Structural Engineers for the new High School at Croesyceiliog School site in Cwmbran. The development involves the construction of the new school in two phases to allow the existing school to operate during the build.

Phase 1 incorporates the construction of the 11-16 year school building, Sports Hall and Hub with new car parking provisions and parents drop-off facility accessed by a new spur off the Turnpike Road roundabout. A shared surface will be installed from the main pedestrian access to the school from Woodland Road as well as additional highway safety measures on Woodland Road, including the introduction of a new pedestrian crossing.

Phase 2 commences once possession of the new buildings are complete. The existing school buildings will be demolished to allow construction of a 3G all weather mixed use games area with flood lights and completion of the main car parking area.

The proposed development site is full of engineering constraints; the site falls significantly from Woodland Road/ Turnpike Road down to towards the Afon Lwyd, has numerous Public sewers, a significant culverted watercourse, strategic water mains passing through the site as well as live BT, gas and electric services below ground.

Cambria Consulting are using Civils 3D ground modelling software to inform the design process, primarily to design the levels across the site to minimise earthwork operations and reduce the requirement of importing and export material to and from site.



Image provided by Stride Treglown

The planning application is programmed to be submitted by July this year. Cambria are providing a Transport Statement, Travel Plan, Phase 1 Environmental Assessment (Desktop Study), FCA and Drainage Strategy Report in support of the application.

Ysgol Newydd Margam, Port Talbot



Client:	Neath Port Talbot Council	
Contractor:	Bouygues UK	
Architect:	Stride Treglown	
Sector:	Education	
Value:	£26m	Completion Date: 2018
BREEAM:	Excellent	

Cambria Consulting are the appointed Civil and Structural Engineers responsible for delivering the engineering scope for this BIM Level 2 project in Neath Port Talbot on behalf of Bouygues UK. This project forms a key part of the 21st Century Schools programme.

Ysgol Newydd Margam will be located on the site of Dyffryn Upper Comprehensive School and Groes Primary School. The school will accommodate 1200 pupils aged 11-16, 210 pupils ages 4-11 and 45 nurse places.

The structural solution for the project consists of a braced steel frame with composite beam and slab floors. A number of storey high trusses were included with the steel frame solution in order to accommodate the architectural visions of large open circulation spaces while still providing second floor teaching over.

The foundation for the steel frame consisted of reinforced concrete pads and strips on good bearing strata however, the area of fill requires that the foundations be taken down to the good soils with trench fill solution. The ground floor slab also required careful coordination of suspended slab in areas of fill with a more economic solution of ground bearing slab where possible.



The site presented many challenges including respecting the no construction zone adjacent to the existing Arnalt Brook, to which takes discharge from the SEWTRA owned culvert serving the M4 Motorway. 3D modelling software was used extensively to provide exceedance flood flow routing paths on the site.

In order to achieve cut & fill balance and minimise retaining wall structures the scheme was constantly modelled using 3D Design Software.

Tiny Rebel, Rogerstone



Client:	Tiny Rebel Brewery Co	
Contractor:	EVOL Wales Ltd	
Architect:	Powell Dobson	
Sector:	Commercial	
Value:	£2.6m	Completion Date: May 2017

Cambria Consulting are the appointed Civil and Structural Engineers chosen for the refurbishment proposal of Unit 2, Wern Industrial Estate in Rogerstone, Newport.

The proposed development will house a new Tiny Rebel Brewery, along with a bar and office space.



CAMBRIA

Constructive Thinking

The redevelopment of the 1.5 acre site includes 30,000 square feet of internal space with a new production area, a large entertainment and events space alongside a bar/kitchen and associated offices. The remaining 35,000 square feet of external space will be utilised for production, additional events space and a mini basket ball court.



The scheme involves significant structural alteration works to the existing portal frame building to increase available height and introduce a new mezzanine floor space to meet the clients requirements. The mezzanine includes predominantly office space with feature cantilever areas housing a meeting room and a balcony space overlooking the large open-plan bar. The new front entrance cantilever canopy contributes to an impressive building façade. A large external terrace has been created from reclaimed compacted fill behind reinforced cavity fill retaining walls.



This flagship project was completed in May 2017.

The Mill, Cardiff



Client:	Tirion Homes Ltd	
Contractor:	Lovell Homes	
Architect:	Powell Dobson	
Sector:	Residential	
Value:	£100m	Completion Date: 2022

Cambria Consulting are appointed Civil and Structural Engineers on this new £100m “Urban Village” regeneration programme located on the former Arjo Wiggins Paper Mill site, Cardiff.



As one of Wales' biggest regeneration programmes, the project will consist of regenerating a 53 acre industrial site on the banks of the River Taff. The regeneration will deliver approximately 800 properties, set to be affordable homes that will range from one bedroom apartments to four bedroom detached houses. The first 102 homes are set for completion by the end of 2017.

The site will also include a number of public facilities such as a village centre, open spaces, riverside footpaths, cycleways, a doctors surgery and a variety of shops.



Cambria's involvement in this project includes the Civil and Structural design of the on-plot access roads, parking and circulation areas as well as the design and detailing of the surface and foul drainage systems serving the site. Sub and super structure designs will also be provided by Cambria.

Little Thurrock Eco Village, Essex



Client:	Nordor Holdings Ltd
Contractor:	TBA
Architect:	Delta Architects
Sector:	Residential/Commercial
Completion Date:	TBA

Cambria Consulting has an important role which involves supporting our Client in their Planning Application to develop this 14 Hectare marshland site for residential development which also includes delivering a Community Centre and Light Industrial units.

The site is low lying with typical ground levels ranging from +1m to -0.5m AOD and is also designated as being at risk of flooding being located between the River Thames and the Tilbury Marshes Reservoir.

Cambria was tasked with securing Environment Agency and IDB approvals to the proposed Flood Risk mitigation works and the Surface Water Strategy for the site to enable the site to be developed. To this end hydrodynamic flood models were created to simulate the pre- and post-development situations for the 100 and 1000 year storm events plus allowances for climate change effects.

Further models were created with and without the proposed mitigation works in place in order to demonstrate that the completed development had zero effect on the risk of flooding to the surrounding area. This modelling was further enhanced to demonstrate that all areas remained safe in the event of a breach to the Tilbury Marsh Reservoir. With all this modelling and data submitted our Flood Risk Assessment and Addendum Reports were accepted by both the Environment Agency and Internal Drainage Board who then removed their standing Objections allowing the Planning Application to be recommended for Approval.

Cambria also provided a detailed Transport Assessment Report to demonstrate that the development would have no significant effect on the local highway system and our report was also used to minimise the S106 contributions for the off-site highway works. Our Highway related work also included the detailed design of the internal road system to enable them to be accepted by the local highway authority for future Adoption under a formal S38 Agreement.

Vanguard Self Storage, Bristol



Client:	Vanguard Self Storage Ltd
Contractor:	TBC
Architect:	Oxford Architects
Sector:	Commercial
Value:	£3m
Completion Date:	July 2018

Cambria Consulting role on this project involves the re-development of a derelict inner city site to create a state of the art self storage facility with a distinctive 'Whaw' factor for all staff and visitors alike.

The existing, gently sloping site was occupied by derelict garage facilities on circa 50% of the site with the rest occupied by the robustly constructed 'Shiner' building which had been abandoned for some years.

The proposed self storage facility involves building a new glass fronted warehouse on the previously demolished garage area to house 4 storeys of the self storage units which would be installed within the completed building as required to meet increasing demand. The Shiner building, which is of substantial robust construction with ample headroom and floors designed to support an imposed loading of 30Kn/m², is being provided with additional intermediate floors installed as an integral part of the proprietary storage system.



The full height open space between the new warehouse and the Shiner building provides a spectacular space with coloured glass panelled clear spanning bridges providing direct access between the new and the old buildings at all floor levels. A further feature of this space will be the BAC (English Electric) Lightning Jet Fighter which will be hung from the roof in its impressive steeply inclined attack mode. The fighter's twin Firestreak missiles, twin Aden 30mm guns and its two Rolls Royce Avon 301R Turbojet Engines capable of taking the fighter to Mach 2.27 and above 60,000ft will - however - have all been removed!

9. Client Testimonials

Remember the testimonials from our
Company Profiles for 2015 and 2016...

powelldobson
ARCHITECTS

 **KIER**

 **North
Somerset**
COUNCIL

MORGAN
SINDALL

 **jemca**
love every journey





 **Stride Treglown**


WILLMOTT DIXON
SINCE 1852



GreenSquare
Construction



CAMBRIA

Constructive Thinking

Here are our new testimonials received for 2017...



"This is my second project with Cambria and the fantastic work continues, Gary and the team are approachable and will always look alternative engineered solutions where required to make things easier faster and cheaper.

They have fully embraced the open door culture of the projects we've worked on and as a result they are fundamental part of the contractor, consultant and most importantly client team. The second project wouldn't have happened without it."

Projects Director
Bouygues UK

Tirion.

"Tirion Developments are pleased to confirm that they have successfully worked with Cambria Consulting on the Whiteheads regeneration project in Newport and would have no hesitation in recommending their services."

CEO
Tirion Group Ltd

LOVELL

"Cambria are acting as consulting engineers on a number of high profile developments we are currently engaged with, not least our prestigious project at The Mill, Canton. Regeneration of brownfield sites represents a large part of our core business and Cambria's expertise and ability to come up with innovative engineering solutions play a key part in unlocking such developments and thus making them viable. We look forward to continuing our successful relationship on future schemes.

Regional Technical Director
Lovell Partnership Ltd



"Boyes Rees are working with Cambria Consulting on the Trago Mills Project for Kier Construction , for both the bid stage and delivery on site. We have worked together very well on this demanding project and look forward to a successful outcome. We look forward to continuing our on-going relationship on future opportunities."

Operations Director
Boyes Rees

CAMBRIA

Constructive Thinking



“The local Team at Cambria led by both Wynn and Callum is currently working on a number of projects with Wates and provide sound technical advice, is conscious of Developers/ Contractors economic requirements and is proactive in providing value engineering options.

Cambria is passionate in their views, always contribute well in meetings and assist in resolving issues regardless of the many challenges that are thrown at them. Cambria also has a good rapport and relationship with key agencies involved which does assist in approving their design work.”

Senior Design Manager
Wates

Reference

The following information is provided as a useful 'high-level' aide memoire.

If your reliance is critical please contact this office.

10. Concrete vs. Steel Construction

Today's buildings are being created in a vast array of different shapes and sizes using an ever-increasing selection of building materials, however, the core materials for building and designing structures have remained invariably the same for decades. Whilst timber and glass structures, amongst other new emerging forms of construction are becoming more common, concrete and steel framed buildings remain the principal choice of material for designing medium to large scale structures.

The decision as to which material to use in designing a structure will be based on several variable factors. It is not just for the structural engineer to decide on the main form of construction material but the whole design team, as different parties will have different requirements which can be considerably affected by the choice of structural form.

The decision on which form of construction to use on a project is not simply down to raw material cost, as there are multiple other whole life cost considerations that can affect the cost of a project. Other key factors that should be vigilantly considered when choosing a base structural material include building function, structural form, site environment, aesthetics, buildability, programme, sustainability and logistics.

In the following sections, we consider the benefits and drawbacks of both concrete and steel framed buildings.

10.1 Concrete

Advantages

- High compressive strength – 30-300 N/mm² (30-60 N/mm² for RC25/30 to RC 50/60 typically used in reinforced concrete)
- Relatively low density – 2,450 kg/m³ (25 kN/m³)
- Flexible geometry/ease of use
- Precast
- Fire protection inherent
- Use of waste materials
- Thermal mass
- Low cost per m³
- Smaller contractor compound required
- Generally slimmer structured zone

Disadvantages

- Heavier construction – generally larger/deeper foundations
- Low Young's modulus – 30-50 kN/mm²
- Long-term creep
- Site labour intensive – formwork (although this is becoming more efficient)
- High embodied carbon



Castleoak Windsor - Concrete Structural Model

Concrete is the worlds most widely used man made material, due to its worldwide availability, flexibility of use for a variety of structures, and relative low cost.

Concrete has a high compressive strength which makes it a suitable load bearing material, conversely it has a low tensile strength and requires steel reinforcing bars to provide tensile capacity.

Concrete is formed by mixing cement, fine and coarse aggregates and water (as well as some other admixtures which can enhance the concretes properties in various ways). A percentage of cement replacements can be added to the mix to reduce the cost and whole life embodied energy of the cement. The most common cement replacements are PFA (pulverised fuel ash) and GGBS (ground granulated blast-furnace slag) which are reused by-products from coal-fired power stations and steel production respectively.

Aggregate in differing fine/course sizes from 0.1-2/10-20mm and shapes/roughness is required to fill the voids within the concrete mix. The ratios of which can affect the concrete's workability, bond strength and finish. Recycled aggregates can be used, such as crushed brick and concrete to further lower the whole life embodied carbon of the concrete.

Other limited quantities of various admixtures can be added to the mix to change the concrete's properties depending on the required use. Numerous types of admixtures can be added to affect the strength, flow, density, hydration, workability, waterproofing and colour.

Concrete's surface and texture can be specified in a variety of shapes and forms to create an aesthetically pleasing finished product.

Mass concrete possesses a very low thermal conductivity rate which enables concrete to provide beneficial insulating properties, making it capable of retaining large amounts of heat energy which it will slowly emit on cooling. Thermal mass can be utilised to passively regulate a building's internal environment, thus cutting down on energy usage for heating and cooling.

Concrete can be a very durable material as long as it is designed with care and the on site construction is carried out as specified by a responsible contractor/site team. Failure to provide sufficient cover to the reinforcement or significant cracking to the concrete can allow corrosion of the reinforcing bars which can lead to spalling.

Due to concrete's popularity in construction and the frequent use in multiple forms of construction, concrete production creates more than 5% of the world's CO₂ production.

10.2 Steel

Advantages

- High tensile strength – 250-1000 N/mm² (typically 275 or 355 N/mm² for mild structural steel)
- High Young's modulus – 205 kN/mm²
- Lighter construction – generally smaller/shallower foundations
- Fabrication precision
- Fast erection on site
- Offsite construction/fabrication
- Future flexibility



Margam School - Steel Structural Model

Disadvantages

- Lead in times
- High density – 7,800 kg/m³ (78.5 kN/m³)
- Supplementary fire protection required
- Corrosion
- High embodied carbon
- High cost per m³

All forms of steel are created from alloys of iron, carbon and other alloying elements. Structural steel is formed of an alloy of iron, less than 1.6% carbon and several other alloying elements. Structural steels are known as low carbon steels. Hot rolled structural steel is formed and shaped into multiple standard section sizes by pressing/rolling molten steel at high temperatures (under 1,000°C). The most commonly used structural steel grades are S255 and S355, however higher grades of S420, S460 and above are available but rarely required and less common.

Bespoke structural members and connections can be formed where required by casting molten steel into moulds, although this can be expensive, especially if not required in bulk quantities.

Cold formed sections are created by working steel sheets beyond their elastic limits in order to retain a specific shape typically less than 2mm thick. These sections are then used as metal decking, cladding rails and other shapes.

Stainless steels are produced by adding up to 20% of chromium and 12% of nickel to the mix which enables a bright chromium oxide surface layer to form which is resistant to oxidation, thus protecting the ferrous steel.

When exposed to high temperatures during fire exposure, due to its high thermal conductivity steel undergoes a significant reduction in strength capacity. Therefore, the design must consider if additional fire protection is required, usually in the form of protective coatings such as intumescent paint, fire board or concrete encasement.

The durability of steel is affected by electrochemical corrosion due to water and air but can be protected by coating steel in layers of painting systems, metallic coatings (galvanised) or plastic coatings. Alternatively, stainless steel or weathering steel can be used.

10.3 Sustainability

Sustainability should be a key consideration with every decision that a design team makes, however, sustainability is defined in many different ways and different disciplines within the design team will have various requirements for every type of building. A sustainable design should not only consider environmental issues but economic and social issues in equal measure, although all these factors should be considered on project by project basis. There's no single right or wrong answer as each building needs to be considered on merit of its intended use, form, size, programme, location, cost, aesthetics, quality of finish, future flexibility and other factors.

A building's sustainable credentials should be considered over the structure's whole life cycle, from conception, through design, transport, construction, use and maintenance to re-use or demolition and disposal. All structural materials should take into account both embodied carbon (eCO₂) as well as operational carbon (oCO₂) and energy (eE & oE). An efficient structural design should use appropriate design codes and material selection to provide a suitably utilised structural capacity, whilst leaving some scope for future flexibility.

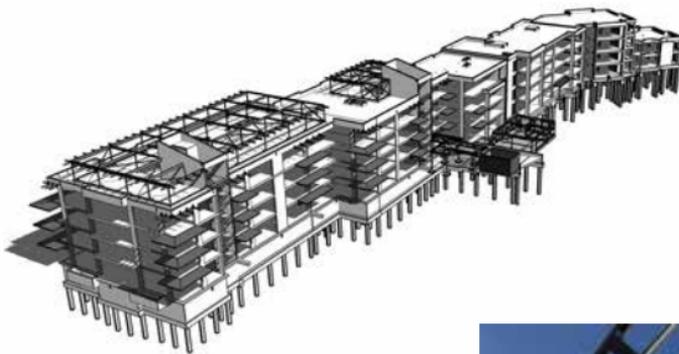
CAMBRIA

Constructive Thinking

Currently a structure's embodied carbon makes up circa. 20% of a building's emissions, with mechanical and electrical systems making up the remaining 80%. However, this is changing and if Structural and Civil Engineers don't take action and improve the efficiency/sustainability of the structure it could equal out in years to come.

As stated previously concrete construction can utilise cement replacement materials created as by-products of coal-fired power stations and steel production, as well as reusing recycled aggregates.

Steel can produce lighter structures which in turn allows for smaller/shallower foundations, and steel can be melted down and recycled plus the GGBS by-product can in turn be used in concrete mixes.



Concrete Model of
Castleoak Windsor

Tiny Rebel
Cantilever Roof



11. BIM

As one of the more recent acronyms to appear within the construction industry, BIM, is used as a means of describing virtual design, construction and facilities management.

There are various definitions of what BIM is and it often depends on your point of view or what you seek to gain from the approach. Sometimes it's easier to say what BIM is not;

It isn't just 3D CAD, it's not a new technology application and It's not next generation, it is being done now!

BIM is essentially value creating collaboration through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them.



Cardiff West - Work in Progress

So, what do the letters mean?

'B': Building; for some of us this may relate to everything within the building envelope, but, to others, the building plus surrounding infrastructure - roads, drainage and landscaping.

'I': Information, this is the key word out of the three. The virtual 3D models do not only contain intelligent objects, they are also a database of product data and all sorts of other non-graphical information.

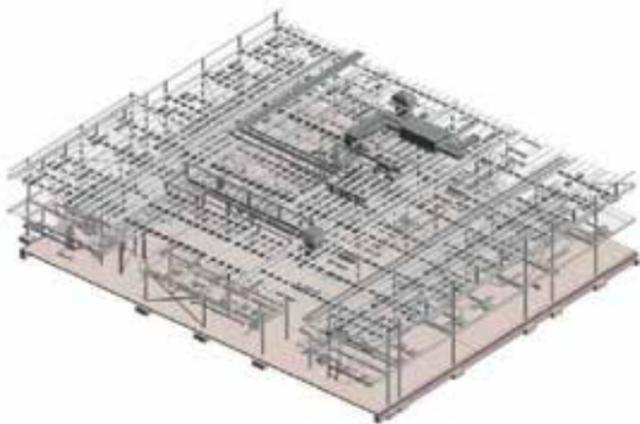
'M': this has a few different meanings, it can be a model, the task of modelling, or management.

BIM is both a noun and a verb. A 'model' is created by Cambria's experienced structural team 'modelling' using 3D design and analysis software packages, these are fully coordinated with architectural and services models. The model can also be used by the fabricator to save time on project delivery.

Cambria's 3D models are being used by contractors for project programming, this includes a time facet, and is classed as 4D BIM. Accurate cost estimates from the components of the information model can then be calculated and it's this process that is known as 5D BIM.

Those estimates can consider the capital cost of purchasing and installing a component, the running costs associated with it once in use and the anticipated price of renewing it in the future - all based on the data and information associated and linked to that particular component.

With the graphical model and its attribute data developed, Cost Managers can very quickly determine the quantity of a building component, applying rates to those quantities to reach an overall cost for that package. Those packages costs are then combined to build an overall picture of a project's cost.



Cardiff West High School

Once the construction is completed, the client may take a copy of the model for their facilities management, this is classed as 6D BIM. This refers to the intelligent linking of individual 3D CAD components or assemblies with all aspects of project life-cycle management information.

The 6D model or Asset Information Model (AIM) is usually delivered to the owner when a construction project is finished. Asset Information Requirements (AIR) is something that needs to be agreed with the client right at the beginning of the project so the project team have a clear understanding of the output and future use of the AIM.

The 'As-Built' BIM model is populated with relevant building component information such as product data and details, maintenance/operation manuals, cut sheet specifications, photos, warranty data, web links to product online sources, manufacturer information and contacts, etc. This database is made accessible to the users/owners through a customized proprietary web-based environment. This is intended to aid facilities managers in the operation and maintenance of the facility.

In May 2011, the UK Government published the Construction Strategy aimed at reducing the cost of public sector assets by up to 20% by 2016.

To achieve this strategy, the government requires construction suppliers tendering for centrally-procured government projects to be working at BIM Level 2. As a minimum, they require fully collaborative 3D BIM (with all project and asset information, documentation and data being electronic). The requirement has been introduced to drive the adoption of BIM processes throughout the public and private sector.

BIM Level 2 was introduced as a requirement for all government construction projects from April 2016. In a nutshell, BIM Level 2 defines what, when and how information should be created, shared and managed.

Cambria operate at BIM level 2 for most project work, as standard. We have developed vast experience over many successful projects, with the sharing of information for both construction and operation at our core. Experience gained through our projects has given us the ability to collaborate either as part of a project team or as the project lead.

Level 0 - In its simplest form, level 0 effectively means no collaboration. 2D CAD drafting only is utilized, mainly for Production Information. Output and distribution is via paper or electronic prints, or a mixture of both.

Level 1 - This typically comprises a mixture of 3D CAD for concept work, and 2D for drafting of statutory approval documentation and Production Information. CAD standards are managed to British Standards (BS 1192:2007), and electronic sharing of data is carried out from a common data environment (CDE), often managed by the contractor. This is the level at which many organizations are currently operating, although there is no collaboration between different disciplines – each publishes and maintains its own data.

Level 2 - This is distinguished by collaborative working – all parties use their own 3D CAD models, but not necessarily working on a single, shared model. The collaboration comes in the form of how the information is exchanged between different parties – and is the crucial aspect of this level. Design information is shared through a common file format, which enables any organization to be able to combine that data with their own in order to make a federated BIM model, and to carry out interrogative checks on it.

Hence the CAD software that each party uses must be capable of exporting to one of the common file formats such as IFC (Industry Foundation Class) or COBie (Construction Operations Building Information Exchange). This is the method of working that was set as a minimum target by the UK government for all work on public-sector work by 2016.

Level 3 - Currently seen as the holy grail, this represents full collaboration between all disciplines by means of using a single, shared project model which is held in a centralized repository. All parties can access and modify that same model, and the benefit is that it removes the final layer of risk for conflicting information. This is known as 'Open BIM'.



Moving forward with BIM

As BIM has become more of a regular feature within the built environment, the industry has become more comfortable with utilising its benefits. Regular, visually based design team meetings have become the norm. As this method of collaboration becomes more entrenched the 'Information' part of the acronym is becoming more important. As all parties within the team learn that they can add, and access a wide range of information within the project model quickly and easily.

As well as bringing more sub-contractors within the scope of BIM and earlier in the design process, the 3D nature of the modelling itself has improved the speed of the project delivery by improving areas such as the communication of the building structure to the steel fabricator. By sharing an IFC model this reduces the fabricator's modelling time and cuts down on queries within the traditional '2D to 3D' translation as the frame has already been modelled. Other processes are now becoming more commonly included within BIM as the software and technology progresses, for example; reinforced concrete detailing.

Unfortunately, there are still limitations to the current, commonly used software packages, especially on the civil engineering side. There are ways around these limitations and Cambria are pushing the boundaries where possible to allow collaboration and clash detection to be done.

CAMBRIA

Constructive Thinking

Bristol Business Park,
Ground Floor, Building 350, BS16 1EJ

T 0117 911 3333

Cambria House, 16-17a Plas St Pol de Leon,
Penarth Marina, CF64 1TR

T 029 2009 3333

W www.cambria.co.uk



<https://twitter.com/cambriauk>



<http://www.linkedin.com/in/cambriauk>