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Delivering Public Available Specification (PAS) 1192

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Abstract

PAS 1192 defines the specification from the UK Government regarding the delivery of BIM. It is intended to be adopted for both public and private procurement first in the UK and then worldwide. This specification dictates the structuring of design data through the use of various British standards such as BS1192:2007, BS8541 parts 1 to 4, etc... as well as the delivery of design data in new formats such as COBie. But what does this actually mean for the BIM modeller and the Design teams?

This paper explores the impact of PAS 1192 on the software user producing BIM data. They are now authoring data not just for the production of drawings, but specified structured data that can aid the construction process and the delivery of life cycle management, whilst also having to comply with British Standards.

The paper explores how BS1192:2007 CAD terms, such as containers are translated into BIM software terminology. It will also provide guidance on how BS8541 impacts content creation and parameter definitions, as well as exploring how this is translated into data structures and the implications of this for exporting data in formats such as COBie.

The paper will review how projects should be structured in order to work within the enhanced common data environment (CDE) defined with PAS 1192. It will also review the impact of the "status" and "purpose" requirements on those delivering data and the rigor and roles that this will create.

PAS 1192 and the defined British standards define a structured process for the creation and delivery of BIM data. The process must be understood; followed; delivered and authenticated for the savings identified by the UK Government to be achieved. To Quote a phrase "This is not just about BIM, but it's all about BIM..."

Keyword: Building Information Modelling, Public Available Specification 1192, British Standard 1192, UK Government BIM Strategy

Introduction

The UK Government BIM Strategy is the logical extension of a process to improve UK Construction and has been developed to incorporate technological advances using defined processes to improve value and reduce cost. Public Available Specification (PAS) 1192 is the specification document that identifies the requirements for achieving the UK Governments target of BIM Level 2 by 2016.

The UK Government has signed up to the Kyoto Protocol with a long-term aim of achieving a carbon dioxide emissions reduction of some 60 per cent by 2050, with real progress by 2020. The UK Coalition Government was elected in a period of economic recession identified by phrases such as "There's no money left" and "The coffers are empty."

For decades UK Construction has been seen as not providing value for money and Governments have commissioned various reviews of the construction industry highlighting waste and inefficient working methods. Notably these include:

- Latham Report Constructing the Team(1994)
- Egan Report rethinking Construction(1998)
- Egan Accelerating Change (2002)

One of the Latham report recommendations was:

“As the largest single procurer of construction, the government should commit itself to becoming a best practice client.”

In May 2011 the UK Government published the Cabinet Office Construction Strategy. The paper having accepted the importance of Construction to the UK economy, goes on to define an aim of cutting the capital cost of UK Government Building Asset procurement by up to 20% by 2016. The adoption of BIM by this date is seen as one crucial element to achieving this and the UK Government BIM Strategy was developed along with the UK Government BIM Task Group.

AVANTI

In order to implement the Egan principles of Rethinking Construction in 2002 Avanti was initiated. This brought together industry experts to write and develop Standard Method and Procedure/Process (SMP) for CAD and Production Information to be implemented on a series of real live projects. Avanti followed on from the previous studies carried out under the CPIC Construction Project Information guidelines documenting the Heathrow Express, BA Stansted projects and those used on Heathrow Terminal 5.

Avanti developed further the Common Data Environment (CDE) and naming conventions over a series of sponsored projects. The benefits were measured using Key Performance Indicators (KPI's) against similar projects and the appropriate costs estimated against fault resolution. Savings identified suggested 15 to 20% costs could be saved on projects where the Standard methods and protocols were implemented.

The Standard Methods and Procedure / Process (SMP) adopted and proven within Avanti became the basis for the British Standard *“BS1192: 2007 Collaborative production of Architectural, engineering and construction information – Code of practice”* and the following guidance document.

One of the specific areas to be addressed using BIM is the problem of inaccurate and ambiguous information that leads to poor decision making and additional delivery costs as proven within the Avanti Case Studies.

BIM

Building Information modelling (BIM) is held as the “Holy Grail” of construction, with a fully coordinated 3D model with associated information available to resolve all problems within the building lifecycle from Conception to Facilities Management.

The basic concept is to create a virtual graphical model onto which can be hung data to prove that the design meets the Clients brief aesthetically and functionally. It also provides coordinated design data in an understandable format available to improve the construction methodology and delivering to the facility manager information in a format that meets the life cycle needs.

Design Technology advances

The advancements in Information Technologies, specifically mobile, touchscreen and viewing software all have a huge impact on the possibilities to share and communicate information. In construction the design has traditionally been communicated via paper with no guarantee that the paper is the most current or correct source of that information.

These improvements in Design Technology mean that Constructors can access the current up to date, validated information at any time or place through a plethora of devices. However to support the access of information the process must identify what is the latest data, confirm fitness of purpose and facilitate that access.

Data drops

Traditionally Clients have not defined what information they require and when they require it. This raised an issue of the uncoordinated work stages used by professions throughout the construction industry. Each professional body has traditionally defined what services they carry out using their own schedule of works. Each profession is at a different point in their work stage when the delivery of information to the Client is required for the decision process.

The UK government therefore commissioned the Construction Industry Council (CIC) to define the work stages against which the Client can request the appropriate information to make informed decisions. The CIC initiated a BIM working party and initially seven work stages were identified. It was later realised that an initial stage was required so the stages were numbered 0 to 7. The various professional bodies were then asked to align their work stages with the CIC stages. The RIBA has recently carried out this exercise.

Level 2 BIM

The UK Government proscribed that all projects procured by 2016 should use level 2 BIM. But what does this actually mean?

When the proposal to adopt BIM as a working method was reviewed all the issues relating to using BIM such as ownership, commercial arrangements, data management and deliverables, contractual relationships, professional indemnity, intellectual copyright and levels of details were raised as barriers. Specific levels of BIM were labelled in order to elucidate the extent of BIM required. These were identified as BIM Level 1, 2 and 3 as illustrated in the Bew / Richards wedge diagram.

Many companies have been carrying out Silo based BIM in order to improve their own productivity and aid execution of their deliverables. Some designers have shared these Design models with other Design consultant as well as contractors. In other scenarios Contractors had built their own coordinated construction models to facilitate their own deliverable. It was felt that these approaches could be a starting point and that the principles adopted through Avanti should be applied. The basic requirements of BIM Level two are:

- Originators produce information in Models they control
- Clear definition of the Employers Information requirements (EIRs)
- Evaluation of the proposed approach capability and capacity of supplier
- BIM Execution Plan shall be developed by each supplier
 - Roles and responsibilities
 - Standard methods and procedures
 - Master Information delivery Index
- Provision of a Common Data Environment

BIM Level 2 requires very few changes to the existing commercial and contractual relationships, ownership and or consultants terms and conditions. This allows the design team to adopt tried and tested methods of working and sharing data. The purpose is to produce coordinated design data based upon geometry.

BIM Level 2 follows traditional methodology with defined standards, methods and processes for the management and exchange of data as defined with in BS1192:2007. Many have raised professional indemnity as a blocker to BIM. However, as defined within the CIC *“Best practice Guide for Professional Indemnity Insurance when using BIM”* level 2 can be achieved using existing levels of cover and will reduce known risks.

Public Available Specification (PAS) 1192

“Specification for information management for the capital/delivery phase of construction projects using Building information modelling.”

PAS 1192 communicates the explicit set of requirements the UK Government as a Client requires the supply chain to follow. The underlying concept behind the PAS is that you get what you ask for...

For too long the UK Government as Client has commissioned construction without understanding what they are paying for and without measurements to allow comparison (Egan KPI's). In order to alleviate the issue the PAS attempts to ensure that the Client defines what information needs to be provided and when. This allows the Client to make informed decisions based upon supporting formatted data that can be used to analyse and quantify. The rigor put in place will also ensure that the issues of incomplete, inaccurate and information ambiguity are at least reduced from the process, saving both cost and time. In order to expedite this PAS requires each Client to define project specific data needs and so Employers Information Requirements are produced to establish these.

Employers Information Requirement (EIR)

Prior to commencing any project the Client needs to define their information requirements (EIR) for inclusion in a briefing or tender document. This document identifies what information the Client will require from the supply team throughout the Design, Construct, and Manage process to make decisions about the asset and answering project specific queries often described as the “Plain Language Questions”

The EIR may be specific about the many aspects of the project requirements even relating to exchange methodology; data formats; software and versions to be used; programme of data drops and project milestones; Clients strategic purpose and defined project deliverables.

BIM Execution Plan (BEP)

In response to the EIR each task team shall produce their BEP focussing specifically upon how they will implement the requirements. The Key components of the BEP are:

- Roles and Responsibilities
- Origin and orientation
- Project Units and Dimensional Standards
- Project Specific naming conventions
 - Project codes
 - Originator Codes

- Level \ Volume Codes
- Status Codes
- Approvals Responsibility
- Software versions to be used.
- Agreed exchange formats and methodology

In order to ensure that all parties are working to a common methodology it is important that at each project stage the BIM execution plan is reviewed and the relevant requirements agreed with all parties. This formalises the data information creation and sharing strategies and processes to be undertaken by all parties.

Information Delivery

As part of the BEP each Task Team will produce a Task Information Delivery Plan (TIDP) and these in term will be collated to create a Master Information Delivery Index (MIDI). It is important that the appropriate milestones and information requirements are available to allow all parties to contribute to the MIDI and this will need to be monitored and reviewed on a regular basis against each TIDP.

Task team members must be aware of both their own TIDP and the MIDI to ensure that the appropriate information is delivered in accordance with MIDI. Failure of task teams to deliver may impact on subsequent work by other teams affecting the overall project programme.

Again the Key to success is not only documenting this as a management tick box exercise but ensuring that the BEP is communicated to every member of the Task team and reviewed as the project progress. It is the Task Team members who execute these proposals through the course of the project and must understand how to comply with them.

Impact on Users of EIR and BEP

Traditionally the choice of design tool and specifically the version and exchange software options are not dictated by the Client. Also the Client has generally failed to communicate what information they require to make decisions. In order to become a best practice Client PAS 1192 requires the Client to get involved and make those decisions.

For the Design Task Teams this has specific implementations relating to what they produce, when they produce it, how they communicate what they produce, as well as the tools used. Fundamental to this is communication throughout the Task teams of the project specific requirements defined within the EIR and BEP. This will impact on areas such as software procurements. For example Revit has no capability for saving back to earlier versions. Therefore new software purchases may also force the purchase of subscription agreements to allow older versions of software to be run to meet specific project needs.

Common Data Environment (CDE)

BS1192:2007 focussed on production information and the exchange of information for construction using traditional CAD methodologies. PAS 1192 adopts the same principles and applies the exchange mechanism to include all the design stages.

The term used throughout BS1192:2007 and PAS 1192 to describe this is the CDE. This process defines how data is issued, reviewed and shared by all parties. It is the CDE which removes the risk from the BIM process and ensures that data is complete, accurate and fit for purpose.

Two specific data delivery options are dealt with by the CDE which are:

- Model data for collaboration
- Documents for compliance with Deliverables

The CDE manages the exchange of information by defining a process for:

- File sharing
- File Management Procedure
- Recording Input / Output

The CDE provides the framework where each task team can model, coordinate and share information in a structured manor without the issues of ownership, liability, copyright and professional liability impacting the project. The CDE has four specific defined areas and these are:

- Work in Progress (WIP)
- Shared
- Published (For Construction)
- Archive

WIP is each task teams Silo based model which may consist of many federated models. Model data for collaboration is issued to the shared area and other design task team data is retrieved from the CDE to ensure coordination. The models must be coordinated, checked and the appropriate revision and status information provided before moving from the Shared area to Published.

This methodology is well documented within a traditional CAD model and sheets file process which is generally used even on smaller projects. Some BIM software also uses this federated model approach as a standard workflow. When using Autodesk Revit as the software solution a single Revit file workflow convention is often used. Here the model data and supporting documentation coincide in a single Revit project file.

Structuring Revit for work within the Common Data Environment (CDE)

Many mistakenly believe that BIM requires a single Revit project file full of live data to be true BIM. The reality is that this places an unnecessary burden on IT requirements and creates the legal nightmare that Level 2 BIM was intended to avoid. There are also the technical issues that Revit is not necessarily the appropriate tool for all specific project tasks. It is likely that each discipline would benefit from using a federated model approach creating multiple models in differing software solutions to meet the needs of the project. This aids project resourcing, improves model performance and facilitates general working practice as well as being a requirement of Level 2 BIM.

Traditional CAD working methodology following BS1192:2007 uses a series of CAD model files either as Component Library models or Design models referenced together for design coordination or referenced into CAD Sheet files for the production of documentation. This requires specific naming and structuring conventions to aid with this delivery method.

The use of a single Revit project in a Silo based solution has avoided the need to implement these conventions as the models were not issued and never entered the CDE Shared area. Views only, often shared in AutoCAD format from the Revit project were issued to be shared with others to allow them to coordinate the volume strategy.

As the requirement to share a Revit models becomes standard practice then the conventions, standards and data structures are required to expedite this. This requires the Revit project files to structure information using a different approach than traditionally taught to the new user.

It is virtually impossible to have all the geometric, non-geometric data and documentation all validated to the same level of design, definition and detail at the point of issue. Other Task teams do not require Revit projects containing thousands of views, drawing sheets and schedules specific to the output requirements of a another task team or discipline. It therefore makes sense to separate the Design models and also create a separate documentation project to store the task team discipline specific documents to be issued. This allows the separation of the issuing process for Model data for collaboration from that for document design compliance delivery.

Design models with specific shared views should be established for working and coordination purposes. These models can be shared in accordance with the CDE in a similar manner to traditional CAD model files.

A Documentation project serves the purpose of solely providing output in terms of hard copy, schedules, visualisation and other formats from the linked design models to meet the Design compliance delivery. The Revit documentation project may reference various linked models to achieve this.

Project Base point Orientation and setting out

BS1192:2007 as referenced through PAS 1192 requires that all projects should establish a project base point, orientation and setting out. Within Revit this requires the setting up of shared coordinates from a common datum and the definition of project north as opposed to True North in all project files. The establishment and agreement between all parties of a common Grid and Levels datum is also fundamental to the successful coordination of design information and should be agreed early on within design solutions.

It may also be suitable to agree specific named reference planes where project requirements dictate. Again this information needs to be available to all task team members who open the model and it is good practice within Revit to communicate this on the opening splash screen.

Design Process and Coordination

The Design process involves the allocation of 3 dimensional Volumes to represent the overall mass, spatial requirements and use or built items. The term volume strategy is used within PAS 1192 but it must be understood that the volume strategy evolves throughout the design process.

The Building Volume (Overall Mass)

In conceptual design it is common to create a single or a group of volumes to represent the form of the building. The Volume is predominantly used to define the building form in relation to its context, but may also be sliced using floor levels to provide area calculations as justification it meets the needs of the brief.

Rooms and Circulation (Spatial requirements and Use)

Often designs are developed by applying spaces to represent areas or rooms defined within the brief or those necessary for the Building to work. Initially these would be rooms or areas

as defined within the Clients brief, as well as those volumes defined for horizontal or vertical circulation. As the design develops this would also identify volumes for requirements such as structure, service routes etc. As the design develops these volumes may be substituted for more realistic representations of the items required as modelling or design by other members of the task teams take place.

The Brick Wall Volume (Built Item)

As the design model progresses built items are included initially based upon function and these are then defined to represent a built item. A model does not actually include a brick wall, as a brick has no definition within BIM software. Instead a volume representing a wall is placed and family or style assigned to identify it as a brick wall. This would also apply a material providing both graphical representation and metadata such as property set information including specification etc. relative to the type of brick.

Naming Conventions

PAS 1192 references various naming convention within BS1192:2007 and BS8541:2013 Part 1. General good practice should dictate that a resilient naming convention is established for all projects and the items contained therein. The use of standard Characters A-Z and 0-9 along with a hyphen (-) and Underscore (_) only are allowed when naming any item in accordance with the standard. Failure to comply with this could impact information export tools from the BIM to be used in future or even when attempting to create links to COBie etc.

Naming within CAD files and the different file types is generally understood and documented in company CAD Standards. How this terminology translates into a Revit environment is often misunderstood. Whilst some adopt the use of the BS1192:2007 file naming for Revit project files, few actually adopt or realise the full requirements and implications.

The CDE requires all files issued to follow naming conventions defined as well as following specific revision and file status requirements. Within Revit it is likely that as well as sheets, many Revit views will be exported for sharing as separate files in other formats such as DWG, DGN, CSV, GBXML etc. As this data is then moving from WIP into a Shared environment it must be named in accordance with the requirements of BS1192:2007.

Two specific naming conventions for views should be established. One for working views, only used by a single discipline within their WIP area and views to be issued to the Shared area, which again should comply with the naming conventions defined within BS1192:2007

The use of groups within Revit also provides a similar issue. Most model groups are unlikely to be issued separately from the main models. However, those that may require sharing should be also be named in accordance with the standard.

Whilst Revit internally does not use a layer standard upon exporting to CAD formats the Revit in built Classifications are mapped to a layer standard. This needs to be defined at the beginning within the BIM Execution Plan and comply with BS1192:2007.

Ownership

Throughout the BIM Process it is important that ownership is defined and understood. PAS 1192 defines specific roles and responsibilities to ensure that ownership is undertaken and the various British Standards references include for the labelling of ownership.

BS 1192 defines standards for File numbering and Container naming conventions. In traditional CAD software containers are understood to represent layers as these control visibility, presentation requirements, scheduling and data filters.

In Revit due to the ability to filter data through the inbuilt classification systems very few adopt a robust naming convention and of those only a minority have adopted the naming convention for containers established inside BS1192:2007

The first field within the BS1192:2007 container naming convention relates to the role of the creator of the data such as "A" for Architect. The use of the discipline field in all naming conventions will aid the definition of ownership through the model and will become paramount as integrated models are produced.

Work Sets

Within a Revit Model the use of work sets based upon BS1192 containers should be used to identify the owner of data. Similar to a CAD layer a Revit Work set is also a classification that filters, controls visibility and graphical presentation of an element. The level of granularity often found in a CAD layer implementation is unlikely to be required as Revit also offers other solutions to these requirements. It is logical that work set names would be limited to higher level classifications or grouping than used by Layers.

Family and Parameter Naming Conventions

Revit Family files are covered under the definitions defined within BS8541:2013 Part 1 for objects with associated classification attributes. As Revit families include Meta data, called parameters these should be used to identify the appropriate classifications to be adopted.

Care should be taken to provide unique names to ensure data integrity if an integrated model is produced. Naming needs to take into account the unique qualities of a specific family and the various types enclosed. This could include specific differences in geometry or even a unique material, property set or non-geometric parameter.

Parameters should be named in accordance with BS8541-2:2012 which defines attribute naming convention. As Revit Parameters actually use GUIDs as the unique ID as opposed to the parameter name the use of standard shared parameter files is crucial to the successful management of family parameters. The only published UK shared parameter files based upon BS8541-4 2012 are those published by the UK National BIM Library.

The Family, type and parameter data from Revit forms much of the COBie export content. It is the robust nature of the conventions used when creating and naming families along with the parameters which will facilitate a successful export to COBie.

Family Evolution

In order to meet the needs of the project Volume strategy the use of stage specific Revit families, suitable to each data drop or level of definition should be assigned to an entity. In order to reduce superfluous information the level of parameter data should also be typical of the data drop requirements. As the volume strategy evolves the family and types are substituted to a family containing the appropriate information providing both graphical and non-graphical data. Families could include Level of definition parameters appropriate to the data drop stages. This would allow graphical display through filters to aid their use in an integrated approach.

Conclusions

The information produced by the Design Task Teams including the BIM modeller will need to change to be focussed on delivering the information required by the Client at each of the predefined data drops. The working formats, delivery formats, exchange methodology and timescales will change specific to Clients needs and communication of these requirements will be fundamental to the whole design task teams.

The implications of aligning the professional services with the CIC work stages will mean that certain discipline will need to be involved in sharing information far earlier within the process than under traditional processes. However, this should aid the validity of the data produced by the whole team as the appropriate level of development and volume strategy approach should facilitate greater coordination and clash avoidance.

The structuring of the BIM will need to take into account the requirements of the CDE to ensure that accurate, complete and unambiguous data is delivered at the appropriate data drops. The requirements of design development, design options, phasing and the exchange of ideas must also be encompassed within a controlled process.

The importance for the task team to comply with documented standards requires education. Modellers and Designers have traditionally created information only to aid the production of their own deliverables and others they have direct communication with. Naming standards, metadata and graphical controls established are only used to meet the specific needs of the known task teams and aid their delivery process. Each Task Team member is now being asked to create lifecycle data generated to meet not just the needs of the authoring task team, but structured and defined in a method that can be used downstream by others who have not presently defined their needs. This provides a level of responsibility not presently understood.

The key to the success of this whole process is communication. The Employer must communicate what they require, when they require it and how they want it communicated. The Task teams must communicate how they are to achieve this, how they will communicate with one another and meet the needs of the Client. Often one of the failures within the lines of communication is the failure of the management for each task team to communicate to the members of their team the necessary requirements of the Client and other task team members. Communication must be completed through the whole chain from top to bottom and is a continuous process.

The requirements of PAS 1192 appear to create a major change to the way many are presently working. Some are claiming that this will create additional work and further costs to the process. The reality is that PAS 1192 only highlights good working practice and a robust methodology for communication. The EIR and BEP should ensure the flow of structured data through the CIC stages to allow the Client to make the decisions needed. The CDE will ensure that only the appropriate information to meet the specific decision making needs will be produced creating a lean process and removing the cost of creating, checking and verifying superfluous information.

The conventions will ensure that data can be identified, managed, coordinated and used within an interoperable process not only for the purposes required by the author, but those will require that information throughout the entire life cycle. Only the future will tell whether the construction industry is up to this task.

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