NATSPEC// Construction Information

NATSPEC *TECHreport*

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Information classification systems and the Australian construction industry

This NATSPEC TECHreport provides an overview of the use of classification systems for organising construction information for various purposes. It outlines the relationship of existing national systems, including NATSPEC, to ISO 12006-2: 2001 Organisation of information about construction works – Part 2: Framework for classification of information. It also examines the significance of classifications systems for the Australian design and construction industry, particularly with regard to digital information technologies such as Building Information Modelling (BIM).

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CLASSIFICATION SYSTEMS

1 INTRODUCTION

1.1 The need for classification systems in the construction industry

The built environment is the most salient physical product of human society, requiring enormous collaborative effort. Collaboration on this scale entails extensive exchanges of information between large numbers of people for extended durations. Depending on their role, each participant has different information needs and responsibilities at different times during the construction process.

Even the most rudimentary project relies on the participants being able to create, communicate and find relevant information at the appropriate time. The larger the scale of the project, and the greater the number of participants, the more essential it becomes to use methods and systems able to handle the associated complexities of information exchange. Classifying information in a consistent way, agreed by all participants, facilitates clear communication of intent and reduces the incident of misunderstanding, conflict, and wasted resources – this is particularly important in the construction industry because the parties involved usually change from project to project.

2 CLASSIFICATION – A BRIEF OVERVIEW

2.1 Classification schemes

In essence, classification simply means the grouping together of like things according to some common quality or characteristic. This automatically implies the separation of the unlike.[1]

In order to be able to classify a collection of subjects it is at first necessary to define the purpose of the classification. Then the properties of interest to the classification may be distinguished, and finally the subjects can be sorted into classes with regard to the chosen properties.

2.2 Faceted classification

Here, each item is comprehended from multiple conceptual perspectives, or facets. The Oxford Dictionary defines facet as ‘one side of a many-sided body’. Individual subjects are classified by describing them by the appropriate combination of each facet.[1] Facets are usually referred to as ‘Tables’ in most of the classification systems examined later.

2.3 Hierarchical or enumerative classification

A hierarchy, as used in classification, is a series of classes or groups in successive subordination; for example; Literature / English literature / English poetry / Early English poetry, etc. Thus each subject class, (for example, English poetry) falls into a subgroup of a larger group (English literature), which in turn forms part of an even larger group (Literature). Such a classification scheme is created by a process of division, according to certain characteristics. As the process of division continues the hierarchical classification lists or ‘enumerates’ complex subjects. This may be contrasted with a faceted approach, which would list ‘English’ and ‘poetry’ as separate concepts, but not as a complete subject. In a properly designed hierarchical classification each subject should have only one place where it fits into the scheme.[1]

Rather than becoming preoccupied with the abstract intricacies of any given scheme, the guiding principle for ordering subjects should always consider how helpful it is likely to be for most of its intended users.[2]

2.4 Consistent terminology

Different people may use different terms to describe the same item, and individuals may use different terms to describe the same item on different occasions. For day-to-day purposes this might not cause any problems, but within a classification scheme this can cause confusion. For this reason, classification schemes usually rely on agreed definitions of terms and consistent usage.

[1] Hunter, J.E. (1988). Classification Made Simple. Gower, Aldershot.

[2] Foskett, A. C. (1996). The Subject Approach to Classification. Library Association Publishing, London.

2.5 Notation

Notation is a very important consideration. However, a common error is to think that choice of notation is the first step in the compilation of a classification scheme – on the contrary, it is one of the final steps. Notation provides a classification system with a short, unambiguous subject identifier facilitating quick orientation and navigation of the system.

(For fuller coverage of this topic, refer to 'Principles of Classification' by John Cann'[3] http://www.icis.org/siteadmin/rtdocs/images/5.pdf)

2.6 Primary uses of classification systems in the construction industry

Typical items assisted by an information classification system include:

- Organising reference material on construction products, technical matters, costs, etc.
- Structuring the contents of individual documents in a consistent manner.
- Co-ordinating information between individual documents found in sets of documents.
- Facilitating communications between different members of a construction project team.
- Facilitating interoperability of digital systems.

2.7 Existing classification systems for the construction industry

2.7.1 Standards relevant to construction classification systems

See Appendix B for a summary of the relationships between current classification systems and the following standards:

- ISO TR 14177 Classification of Information in the Construction Industry:
- ISO 12006-2 Organization of information about Construction Works – Part 2: Framework for Classification of Information (an evolution of ISO TR 14177).
- ISO 12006-3 Organization of information about Construction Works – Part 3: Framework for Object-oriented Information. In recognition of the need for an alternative 'object oriented' approach. (see Appendix A for an explanation of terms).

ISO 12006-2 has had the most immediate influence on the development of a number of classification systems currently being implemented in Europe (Uniclass) and North America (Omniclass). This influence is a reflection of the trend away from the separate development of incompatible systems by individual countries and the convergence of systems based on shared standards.

2.7.2 The relationship of classification systems to specifications

ISO 12006-2 is very broad in scope. It sets out a framework of Tables for classifying construction information, and recommends titles for these Tables, but generally does not detail their content or structure.

The distinction needs to be made between complete ISO 12006-2 based classification systems, such as Omniclass and Uniclass, and the individual facets or 'tables' of these systems, which provide a classification system within the broader framework, for a specific purpose. The ISO 12006-2 Table A.9 *Work Results (by type of work)* is where the classification system for specification work sections is usually located. Work sections are defined as:

'One or several parts of a building or other facility viewed as the result of particular skills and techniques applied to particular construction products and/or elements during the construction phase. Work sections are usually executed by particular types of subcontractor or groups of operatives. The class is influenced by both inputs (the construction products used) and outputs (the parts of the building or facility constructed) and thus represents a dual concept' – ISO/TR 14177: 1994

2.7.3 Australia

NATSPEC, the pre-eminent master building specification in Australia, is based on a classification system developed by its founder, Bryce Mortlock, in 1989. NATSPEC notation consists of numerical codes of up to four digits. The notation is hierarchical – for example 0311 *Formwork* is a subclass of 031 *Concrete,* which in turn is a subclass of 03 *Structure* (see Appendix E for a summary). There is currently no unified construction information classification system, similar to Uniclass or Omniclass, used nationally for a broad range of classification purposes.

[3] Cann, J. (1997). Principles of Classification. NBS Services, UK and ICIS.

CLASSIFICATION SYSTEMS

The NATSPEC classification system was amended in 2005/2006 when NATSPEC and Masterspec of New Zealand agreed to align their systems more closely. The most recent amendment was in 2007, when a large number of new worksections were introduced following the incorporation of AUS-SPEC, a master specification system used nationally by state and local government bodies for documenting civil engineering, landscaping and infrastructure works, including their maintenance and operation.

2.7.4 New Zealand (NZ)

Masterspec is New Zealand's default standard specification system, managed by Construction Information Limited (CIL) a company owned by the New Zealand Institute of Architects, Registered Master Builders Federation and the Building Research Association. In 1998 CIL took over the work of a previous construction industry organisation and adopted the Coordinated Building Information (CBI) national classification system as the basis for organising Masterspec.

CBI is based on the British Common Arrangement of Work Sections (CAWS) system and Uniclass (See 2.7.10 United Kingdom). CBI modified these systems to take account of local construction customs and practices, and to incorporate a four-level numeric notation that can be used to co-ordinate specification data as well as drawings, product data and research information.

2.7.5 Europe

ISO 12006-2 or its drafts have been applied in the development of the following European classification systems:

2.7.6 Denmark

ISO 12006-2 formed the basis of the Danish DBK system (Dansk Bygge Klassifikation), developed in 2006. Prior to this, a system based on the Swedish SfB system (See 2.7.9 Sweden), called BC/Sfb, was used. The DBK system is part of a wider program called Digital Convergence, which focuses on introducing and implementing shared Information and Communication Technology (ICT) standards in the entire construction sector: email standards, discrepancy lists and web-based project management.[4]

2.7.7 Finland

The Finnish Building 90 system developed by the Building 90 Group and the Finnish Building Centre was published in 1999. It is widely used in the Finnish engineering community.[5]

2.7.8 The Netherlands

The NL/SfB, or 'Elementenmethode', is based on SfB, and is used in the Netherlands for the classification of building elements. The Dutch building specification system, STABU[2], is produced by STABU, which is the abbreviation (in Dutch) for the 'Foundation for a National Standard Building Specification'. STABU was founded in 1975 and produced its first specification in 1986. From its earliest stages, the STABU[2] system was based on a relational database.

In 2005, NL/SfB was connected to the STABU[2] system, making it possible to reorganise work sections to building elements and vice versa. The next proposed development is to link the classification of elements to performance specifications, allowing users to start developing their specifications early in the design process.

Civil engineering works are specified using the RAW specification system. RAW is the abbreviation for 'Standard Conditions of Contract for Works of Civil Engineering Construction', published by the Centre for Research and Contract Standardisation in Civil and Traffic Engineering (CROW). RAW specifications do not use a formal classification system, but are broadly based on work sections and product groups.

2.7.9 Sweden

The first Swedish classification system, developed in the 1950s, was called SfB (Samarbetskommittén för Byggnadsfrågor, Co-ordination Committee for the Construction Industry). The limitations of this system in addressing new developments in the industry led to the introduction of the BSAB (Byggandets Samordning AB, Construction Co-ordination Limited) system in 1972. The Swedish Building Centre (SBC) released the latest revision of the BSAB96 system in 1999. The Swedish national building specification, the AMA, which uses the BSAB96 classification system, was revised and republished by the SBC in 2001. AMA is the abbreviation (in Swedish) for 'General Material and Workmanship Specifications' [6].

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[4] Digital Convergence website: http://www.digitalkonvergens.com/

[5] Building 90 Group and The Finish Building Centre Ltd (1999) Building 90 – The Finnish building classification system The Finnish Building Centre Limited, Helsinki.

[6] McGregor, C. (2001) A description and comparison of national building specifications. International Construction Information Society.

2.7.10 United Kingdom (UK)

The most recent construction information classification system to be implemented in the UK is Uniclass (Unified Classification for the Construction Industry) driven by developments in ICT and international standards for classification systems. The first edition of Uniclass was published in 1997.

Uniclass is a faceted system designed within the parameters of ISO TR 14177. [3] A number of pre-existing classification systems, used for specific purposes, were also incorporated into its 15 Tables; for example:

- CI/SfB (Construction Index/SfB), a derivation of the Swedish SfB system. It forms the basis for table D.
- CAWS (Common Arrangement of Work Sections for building works), developed in 1987, was adopted by the National Building Specification (NBS), the Standard Method of Measurement of Building Works (SMM7), and the National Engineering Specification (NES). Until recently CAWS formed the basis of Uniclass Table J *Work sections for buildings.* (See Appendix E for a summary of Table J). This Table is currently under review.
- CESMM3 (Civil Engineering Standard Method of Measurement) forms the basis of Uniclass Table K Work sections for civil engineering works.
- EPIC (European Product Information Cooperation) Construction Product Grouping (CPG) – or EPIC for short, a common European classification system for construction products, was first published in 1994. EPIC forms the basis of Uniclass Table L Construction products.
- UDC (Universal Decimal Classification) system, a derivation of the US Dewey decimal classification system forms the basis of Uniclass Table Q Universal decimal Classification (see Appendix D for a list of Tables). [3]

Uniclass notation consists of a single capital letter followed by zero or more digits, except Tables J and K, which have two initial capital letters to allow the incorporation of the CAWS and CESMM3 codes. The notation is hierarchical; for example D21, D22, D23, etc. are always subclasses of D2. A number of signs: + / : (colon) < > are used to combine simple class numbers for complex subjects and define relationships of subjects.

2.7.11 North America

The most recent construction information classification system to be implemented in North America is Omniclass. A group of volunteers from organisations and firms representing a broad cross - section of the construction industry recognised a need for classifying construction subjects, the increased use of electronic information technology, and the expanding focus on the complete life cycle of construction. The majority of the 15 Omniclass Tables were published in 2006.

Omniclass is a faceted system designed within the parameters of ISO 12006-2 and ISO 12006-3. Also, Omniclass freely adapted and used Uniclass in its development, and therefore shares many of the Uniclass legacy documents – for example, both use EPIC as the basis of their construction product Tables. The most significant points of departure include:

- The adoption of Masterformat as the basis of Omniclass Table 22 *Work results*. In the same way CAWS is used in the UK, Masterformat is the pre-eminent means of organising commercial and institutional construction specifications, such as Masterspec, in North America. It is published in by the Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC). The most recent edition was published in 2004.
- The adoption of Uniformat as the basis of Omniclass Table 21 Elements (including designed elements). Uniformat provides a standard method of arranging construction information, organised around the physical parts of a facility called systems and assemblies. These systems are characterised by their function without identifying the technical or design solutions that may comprise them. It is used for formatting documents on project scope, quality, cost and time, such as cost estimates or reports (see Appendix D for a list of Tables). [7]

Omniclass notation consists of numerical codes, generally of six digits. These can be extended by adding more digits after a decimal point. The notation is hierarchical (see Appendix E for a summary of Table 22).

2.8 A comparison of existing classification systems

2.8.1 Comparison of Uniclass and Omniclass

- While both systems are based on ISO 12006-2; or its precursor, ISO TR 14177; and there is generally parity between the Tables in each system, each places them in a slightly different order, and each splits or combines some Tables differently. Uniclass adds an extra Table Q, based on the UDC system; for classifying subjects not covered elsewhere in the system.

[7] OCCS Development Committee. (2006) OminClass Introduction and User's Guide – Edition: 1.0, 2006-03-28 Release. Construction Specifications Institute and Construction Specifications Canada.

- There is a high degree of parity between Tables based on the same source documents, for example, Uniclass Table L *Construction products* and Omniclass Table 23 *Products*, which are both based on EPIC. With Tables based on different source documents, we see significant differences in their internal order (see Appendix C for an assessment of the relative parity of Tables in the two systems).
- Omniclass classifies subjects in more detail and information is more clearly presented. This is probably a reflection of the fact that Omniclass was published 9 years after Uniclass, giving Omniclass the opportunity to build on the work of Uniclass.
- Omniclass does not appear to provide an index like Uniclass.
- Omniclass is more readily available – the Tables and supporting documents can be downloaded directly from the web at no cost. The Uniclass manual can only be purchased from RIBA bookshops. Also, there is more evidence of on-going support and development for Omniclass, especially in the guise of Masterformat, than Uniclass. Although there have been recent revisions to Uniclass, and a number of Tables are now under review, it has not been republished since the first edition of 1997 – not insignificant considering the changes that have occurred in the construction industry during this period.

2.8.2 Comparison of Uniclass Table J and Table K and Omniclass Table 22.

These work section Tables are used as the basis of comparison of the classification systems used by the NBS (Uniclass) and the American Institute of Architect's MASTERSPEC (Omniclass) specifications, and as potential influences on Australian specification classification systems.

2.8.3 Preliminary assessment

- Omniclass groups work sections for buildings and worksections for civil engineering works together. Uniclass splits these into separate Tables J and K (see Appendix E).
- Omniclass documents many more subdivisions of each Table than Uniclass.
- Uniclass Table J, *Work sections for buildings* has an internal structure much closer to the Australian approach used by NATSPEC than Omniclass' Table 22 *Work results*. Table J more closely matches the overall sequence of items, and grouping of items. Omniclass Table 22; Division 10 *Specialties,* for example, groups a number of items together which, by Australian conventions, would be located in a variety of locations. This could very well be because Australian construction and subcontracting practices derive much more from English models than North American.
- The structure and notation of Uniclass Tables J and K is very simple, making it more readily comprehensible and easier to navigate. The downside is that it would be more difficult to assign a unique place or notation to items being classified.
- The structure and notation of Omniclass Table 22 are highly subdivided, which makes it easy to find a unique place for many different items, but also makes it difficult to navigate quickly. Although good reasons are given for the notation system,[8] the six digit format is not very user-friendly, though the amended format adopted by Masterformat 2004 has improved legibility. While the difference might not seem that great when viewing Tables in isolation, the larger codes from each Table would become very unwieldy if combined with codes from other Tables – the basis on which faceted systems are designed.
- Omniclass Table 22 provides dedicated maintenance and operation worksections at the beginning of each division – a very useful feature that corresponds to AUS-SPEC worksections recently incorporated into NATSPEC.

Most of the previous comments have been directed at the intrinsic qualities of each system, but issues such as access and availability, which impact on their adoption, also need to be taken into account. In this regard, Omniclass is more readily available, and appears better maintained and supported.

It is encouraging to note that despite the differences between British and North American systems, in broad terms, they have more in common than they have ever had in the past – largely because of the adoption of ISO 12006-2.

2.9 Current trends in the construction industry impacting on classification systems

2.9.1 The impact of information and communication technology (ICT)

ICT has had a profound impact on the working methods of the construction industry. ICT is well suited to the fluid and dynamic environment of design and management processes, compared to traditional paper-based methods. Developments in communications, such as the internet, have also significantly improved the ability to access and distribute information.

The concept of Building Information Models (BIM) is one ICT application to emerge recently that is likely to have significant implications for the construction industry (See Appendix A on BIM).

[8] OCCS Development Committee. (2006) OminClass Introduction and User's Guide – Edition: 1.0, 2006-03-28 Release. Construction Specifications Institute and Construction Specifications Canada.

2.9.2 Interoperability

With respect to software, the term interoperability is used to describe the capability of different programs to exchange data via a common set of exchange formats, to read and write the same file formats, and to use the same protocols. Interoperability relies on software developers adopting agreed standards when creating their applications.[9]

Interoperability is facilitated by standards being open, their specification public, and without restrictions in their access or implementation. It improves communications, maintains the integrity of data, and reduces the prevalence of conflicting and ambiguous information which leads to construction errors, defects and wasted resources. Interoperability is crucial to realise the full potential and benefits of ICT, including applications such as BIM.

The International Alliance for Interoperability (IAI) is the most active organisation promoting interoperability in the construction industry. It is a worldwide alliance of construction industry organisations, comprising 12 international chapters from 21 countries representing over 550 private industry and government organisations. It is dedicated to bringing about coordinated changes for the improvement of productivity and efficiency in the construction and facilities management industry. Australia and New Zealand joined as a chapter in 1997. The IAI now operates under the name BuildingSMART International.

2.9.3 IFC, IFD, IDM and MVD

One of the key strategies of BuildingSMART is the promotion of the Industry Foundation Classes (IFC), a specification for a neutral data format to describe, exchange and share information typically used within the building and facility management industry sector. BuildingSMART have developed and maintained the IFC and facilitated its implementation through mission programs which offer industry-wide forums to identify, test, review, recommend and implement ways delivering quality buildings and services to the facility owner.

The IFC data model consists of definitions, rules, and protocols that uniquely define data sets which describe capital facilities throughout their lifecycles. IFC is the only non-proprietary, open global data model specification available, and in 2002 it became the international standard, ISO/PAS 16793. Software applications supporting IFC are able to exchange data with other applications that support IFC. See http://www.iai-international.org

BuildingSMART has been working with its member organizations and major CAD vendors to put the standard in place. The latest release of the standard, IFC 2x specifies over several hundred object types and related concepts, which support the core exchange needs of the building industry.[10]

Two of the world's largest CAD vendors, Autodesk and Bentley, have both developed BIM solutions (Revit Architecture and Bentley Architecture respectively), which support IFC. Many BIM-associated applications, like those for thermal or structural modelling, are appearing with IFC capability.[11]

Another important interoperability program is the development of the International Framework for Dictionaries (IFD) Library, an object terminology library for the building construction industry. The name is used both for the IFD Library and for the organisation running and maintaining it. The simplest description of IFD Library is that it is a kind of dictionary of construction industry terms that must be used consistently in multiple languages to achieve consistent results – this will enable reliable automated communications between applications.

The structure of IFD is given in ISO 12006-3, which is an EXPRESS model with a short explanation of its purpose and use. (See Appendix A) The first implementations of this standard were the Norwegian BARBi library and the Dutch LexiCon by STABU. Other implementations include EDIBATEC in France. In 2006, on behalf of BuildingSMART, STABU and BARBI combined their efforts on the IFD. The IFD Library is compatible with IFC. See http://dev.ifd-library.org/

The three pillars of the BuildingSMART initiative are IFC, IFD and the Information Delivery Manual (IDM). While IFC is about HOW data is exchanged and IFD defines WHAT is exchanged, IDM is about information requirements, defining WHICH information to share WHEN. The IDM/MVD (model view definition) approach (also an ISO standard in development) forms that specification. IDM regulates the controlled flow of information in and out of a BIM. It's like a contract defining which information will flow, defined by whom, and when. A MVD is more like a subset of the IFC model representing the information of interest to a user, or user group, for a particular purpose.

2.9.4 The continued relevance of classification systems

The need for information classification systems within the construction industry is more pressing today than ever. The information-rich environment of the construction industry increasingly demands appropriate classification systems.[12]

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[9] Wikipedia on-line article. (2008) *Interoperability.* http://en.wikipedia.org/wiki/Interoperability

[10] John Mitchell *What are IFCs? How can they benefit your company and your projects?* (2008) *http://www.graphisoft.com*.

[11] Royal Australian Institute of Architects. (2007) Towards Integrated Practice – A Rapid Tour. (2007) RAIA conference paper.

Some might argue that full text search and keywords make classification obsolete, but data needs to be organised somehow, and it is very convenient if the supplier and user of the data can use the same structure. [13]

Robust industry classification systems have the potential of forming the firm foundations necessary for realising the full benefits of BIM. There are already many existing, widely used computer applications whose full potential could be realised by the adoption of uniform classification systems.

2.9.5 Implementation of classification systems

ICT will have a fundamental impact on the way any new or amended information classification system will be implemented, compared to the implementation of previous paper-based systems of the past. Any classification system is now likely to be created on a computer, distributed by digital means, and used in a digital environment. It would be unrealistic to expect someone working most of the time in a CAD or word processing environment, for example, to refer to a large printed classification manual or index. The nature of classification systems suggests a database platform as their natural vehicle.

2.10 Classification systems for the Australian construction industry

2.10.1 The current position

The need for a comprehensive, widely adopted information classification system for the Australian construction industry has become imperative with the emergence of increasingly data-based applications such as BIM.

The adoption of ISO 12006-2 enables mapping between localised classification systems which have developed worldwide.[14] The increasing numbers of Australian construction industry companies operating in the global market suggest that it would make strategic sense to adopt ISO 12006-2 as the basis of any new classification system.

2.10.2 Development options for a classification system

ISO 12006-2 provides a framework of Tables for a faceted classification system without details about how the content of these Tables should be structured. The NATSPEC classification system is the most widely used national system. It corresponds to the Work Result/Work Process Tables of ISO 12006-2. Few other classification systems exist that immediately suggest themselves as the basis of the other remaining Tables.

The least-effort approach to creating an ISO 12006-2 compliant classification system for Australia would be to simply incorporate the NATSPEC classification into the Work Result/Work Process Table of an existing system such as Uniclass or Omniclass. While expedient, it is unlikely that this would be as well suited to local requirements as a more comprehensive approach.

2.10.3 Requirements statement

With this in mind, any amendment or adoption of a new classification system for the Australian construction industry should meet the following requirements;

- ISO 12006-2 and ISO 12006-3 based.
- Provide high functionality for core needs focusing on the co-ordination of information in all forms of construction documents used throughout the construction process.
- Based on BuildingSMART and open standards to ensure interoperability.
- Facilitate a forward migration path, accommodating current work practices and tools, and anticipating future likely developments in work practices and tools.
- Extensible, making provision for expansion of capabilities.
- Adaptable, allowing individual users to use the parts they require without being obliged to understand the whole system.
- Tailored to the digital environment that most practitioners work in, linking it to CAD, BIM, word processing, email and internet browser applications.

2.10.4 Guiding principles for a classification system development program

- Prioritise development goals according to the immediacy of need.
- Maintain a strategic perspective to avoid closing off future development options.
- Apportion effort on the basis of expected benefits.

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[12] OCCS Development Committee. (2006) *OminClass Introduction and User's Guide – Edition: 1.0, 2006-03-28 Release.* Construction Specifications Institute and Construction Specifications Canada.

[13] Howard, R. (2001) Classification of building information – European and IT systems. Construction Informatics Digital Library.

[14] OCCS Development Committee. (2006) OminClass Introduction and User's Guide – Edition: 1.0, 2006-03-28 Release. Construction Specifications Institute and Construction Specifications Canada.

- Make any system only as complex as it needs to be to satisfy user requirements.
- Borrow from, or adapt, existing systems as much as possible – Do not reinvent the wheel
- Recognise the constraints of local resources for developing systems compared to larger countries – monitor programs elsewhere to avoid duplication of effort.
- Co-operate with CIL (New Zealand) where this is to the advantage of the industry in both countries.
- Monitor the development of systems elsewhere to assess whether industry standards are emerging, and to ascertain when they have reached sufficient maturity to warrant adoption or incorporation into the local system.
- Adopt an open collaborative approach. Apart from the benefits of a wide range of inputs, this would encourage widespread adoption and support – the ultimate measure of a system's success. Contributors would need to be aware that this entails relinquishing intellectual property rights to the project group.

2.10.5 Assessment criteria

- The primary assessment criteria should always be: 'How useful will this be for users?'
- All recommendations and proposals need to be measured against their implications at the implementation stage. For example, if user requirements suggest a custom-designed software application, identify what sort of development program and costs would be associated with it, whether it is likely to be widely used, and whether the benefits will outweigh the costs.
- Specific proposals for the classification system and any associated product, such as computer applications, need to be assessed not just in terms of their production cost, but also their promotion, distribution, support and on-going development costs. That is, a whole systems approach is required to avoid the waste of significant effort. A number of classification systems have only achieved limited adoption due to insufficient promotion and support – for example, the Co-ordinated Classification System (CCS). Other systems, such as those used by construction product information suppliers, such as Infolink and Selector.com, are structured for a web-based environment, and are not necessarily suitable for other classification purposes.

2.10.6 First steps undertaken by NATSPEC to develop an Australian classification system

On the 29th April, 2008, NATSPEC hosted an informal discussion group in Melbourne on classification systems and their relationship to BIM with representatives from architectural and engineering practices. The purpose was to assess the current state of development in this area, and to discuss likely trends and ways of responding to them. A number of points were agreed:

- There was a mandate to make necessary changes to address anticipated developments.
- That steps needed to be taken in this direction straight away because of uncertainty about how long it would take for international standards to be formally adopted.
- Not to try to solve everything at once, but to take cost-effective steps in the right direction.
- The immediate requirement was to develop a consistent indexing/tagging system that provided a correlation between items on drawings, specification clauses and material and product information.

In response, NATSPEC has made the following recommendations:

- Comply with the framework for classification of construction information provided by ISO 12006-2. The reason for adopting this standard is that it has already been adopted by North America and a number of European countries. Not only does this provide a number of potential models for an Australian system, but it is more likely to facilitate the exchange of information between national classification systems and interoperability between ICT applications like BIM.
- Adopt NATSPEC classification for the *Work results and Work processes* Table of the proposed classification system.
- Expand listings in the NATSPEC classification to include items suggested by the construction industry.
- Outline a number of key tables including those for *Elements, Work results and Work processes, Products* and *Materials*.

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ISO 12006-3: 2007 *Organization of information about Construction Works – Part 3: Framework for Object-oriented Information.*

ISO/PAS 16739:2005 *Industry Foundation Classes, Release 2x, Platform Specification (IFC2x Platform)*

5 APPENDIX A: TERMINOLOGY

5.1 Classification terminology from ISO TR 14177: 1994

Classification: a set of concepts arranged systematically according to chosen characteristics or criteria.

Classification class: a high-level unit within a *classification* expressing a main concept.

Class definition: a formulation of the essential characteristics of a *classification class* which draws a clear boundary between it and other *classification classes*.

Classification item: a single defined concept, unique within a *classification class*.

Classification notation: a system of codes expressing the arrangement of a *classification.*

Classification term: a designation of a *classification class* or *classification item* by a linguistic expression.

5.2 Object class terms from ISO 12006-2: 2001

Construction agent: human participant in the construction process.

Construction aid: material construction resource not intended for incorporation in a permanent manner in a building or other construction entity.

Construction complex: two or more adjacent construction entities collectively serving one or more user activity function.

Construction entity: Independent material construction result of significant scale, serving at least one user activity or function.

Construction entity lifecycle stage: period of time in the lifecycle of the construction entity identified by the overall character of the construction process, which occurred within it.

Construction entity part: solid (as distinct from liquid or gaseous) material part of a construction entity having physically delineated boundaries.

Construction information: information used to support one or more construction processes.

Construction object: object of importance to the construction industry.

Construction process: process which transforms construction resources and construction results into construction results.

Construction product: material construction resource intended for incorporation in a permanent manner in a building or another construction entity.

Construction resource: construction object used in the construction process to achieve a construction result.

Construction result: construction object which has formed or changed in state as the result of one of more construction processes, utilising one or more construction resources.

Designed element: element for which the work result(s) have been defined.

Element: construction entity part which in itself, or in combination with, other such parts fulfils a predominating function of the construction entity.

Management process: construction process with the purpose of planning, administering or assessing.

Object: any part of the perceivable or conceivable world.

Project stage: period of time in the duration of construction project, identified by the overall character of the construction processes which occur within it.

Space: three-dimensional, material construction result contained within, or otherwise associated with, a building or other construction entity.

Work process: predominant construction process, which results in a work result.

Work result: construction result achieved in the production stage, or by subsequent alteration, maintenance or demolition processes.

APPENDIX A: TERMINOLOGY

5.3 Other terms

BIM

BIM stands for Building Information Models or Building Information Modelling. The American Institute of Architects (AIA) has defined BIM as "a model-based technology linked with a database of project information", and this reflects the general reliance on database technology as its foundation. [15] While BIM incorporates the 3D modelling capabilities of earlier software, its real power is derived from the fact that individual objects representing component parts of the total model have data files associated with them. In traditional CAD systems 3D objects were graphical entities only, such as lines, arcs and circles. With BIM systems the data file associated with each object in the model can hold information on a large number of attributes, such as weight, structural, thermal and acoustic properties, power requirements, heat and light output, cost, manufacturer's details and maintenance requirements. In addition, relationships to other objects, beyond simply spatial ones; such as constraints and rules of interaction; can be defined.

BIM is called a rich model, because all objects in it have properties and relationships and this information can be mined for data. [16] Quantities and shared properties of materials can easily be extracted. Scopes of work can be isolated and defined. Simulations can run to determine the structural, thermal and acoustic behaviour of a proposed building. BIM can be used to demonstrate the entire building life cycle, including the processes of construction and facility operation.

BIM provides the potential for a virtual information model to be shared by the whole design team (architects, surveyors, consulting engineers, and others), allowing all parties to work on a single, up-to-date model – a concept called integrated practice. This information model can also be passed on to contractors, facility managers, etc so that they can extract information of interest to them. The major benefit of a BIM is that individuals with different information needs can filter out the bulk of information not relevant to their needs, while still knowing it has been co-ordinated with the total model, and is up-to-date at the time of inquiry.

5.4 Express

A conceptual schema language which provides for the specification of classes belonging to a defined domain, the information or attributes pertaining to those classes (colour, size, shape etc.), and the constraints on those classes (unique, exclusive etc.). It is also used to define the relations which exist between classes and the numerical constraints applying to such relations.

5.5 Object oriented programming

A type of programming in which programmers define not only the data type of a data structure, but also the types of operations (functions) that can be applied to the data structure. In this way, the data structure becomes an object that includes both data and functions. In addition, programmers can create relationships between one object and another. For example, objects can inherit characteristics from other objects.

One of the principal advantages of object-oriented programming techniques over procedural programming techniques is that they enable programmers to create modules that do not need to be changed when a new type of object is added. A programmer can simply create a new object that inherits many of its features from existing objects. This makes object-oriented programs easier to modify.

[15] CRC Construction Innovation. (2007) Adopting BIM for facilities management – Solutions for managing the Sydney Opera House. CRC Construction Innovation.

[16] Royal Australian Institute of Architects. (2007) Towards Integrated Practice – A Rapid Tour. (2007) RAIA conference paper.

6 APPENDIX B: RELATIONSHIP OF CURRENT INFORMATION CLASSIFICATION SYSTEMS TO INTERNATIONAL STANDARDS

(Refer Appendix A for some definitions)

Appendix B: The relationship of current information classification systems to international standards (Refer Appendix A for some definitions)

CI/SfB	ISO/TR 14177: 1994	ISO 12006-2:2001			Uniclass (UK)		OmniClass (North America)	
Table reference	**Class**	**Class**	**Principle of specialisation**	**Table ref.**	**Table reference**		**Table reference**	
0- Physical environment	Facilities	Construction entity	Form	A.1	E	Construction entities	12	Construction entities by form
			Function or user activity	A.2, A.6	D	Facilities	11	Construction entities by function
		Construction complex	Function or user activity	A.3, A.6				
	Spaces	Space	By degree of enclosure	A.4	F	Spaces	14	Spaces by form
			Function or user activity	A.5, A.6			13	Spaces by function
1 - Elements	Elements	Construction entity part	Classified by related tables for elements, designed elements and work results	A.7, A.8	G	Elements for buildings	21	Elements (including designed elements)
					H	Elements for civil engineering works		
		Element	Characteristic predominating function of the construction entity	A.7	G	Elements for buildings		
					H	Elements for civil engineering works		
		Designed element	Element by type of work	A.8	G	Elements for buildings		
					H	Elements for civil engineering works		
	Work sections	Work result	Type of work	A.9	J	Work sections for buildings	22	Work results
					K	Work sections for civil engineering works		
		Work process	Classified by related table for work results		J	Work sections for buildings		
					K	Work sections for civil engineering works		
4 - Activities, requirements	Management	Management process	Type of process	A.10	B	Subject disciplines	32	Services
		Construction entity lifecycle stage	Overall character of processes during the stage	A.11	C	Management	31	Phases
		Project stage	Overall character of processes during the stage	A.12				
1 – Elements, 2 - Constructions, forms, 3 - Materials	Construction products	Construction product	Function	A.13	L	Construction products	23	Products
4 - Activities, requirements	Construction aids	Construction aid	Function	A.14	M	Construction aid	35	Tools
		Construction agent	Discipline	A.15	B	Subject disciplines	33	Disciplines
					C	Management	34	Organisational roles
		Construction information	Type of medium	A.16	A	Form of information	36	Information
2 - Constructions, forms, 3 - Materials	Attributes	Property/ characteristic	Type	A.17	P	Materials	41	Materials
					N	Properties	49	Properties
					Q	Universal Decimal Classification		

APPENDIX C

7 APPENDIX C: DEGREE OF PARITY BETWEEN INDIVIDUAL TABLES OF UNICLASS AND OMNICLASS

Appendix C: Degree of parity between individual tables of Uniclass and Omniclass

Uniclass (UK) Table reference		Source Documents (other than ISO TR 14177)	Omniclass(North America) Table reference		Source Documents (other than ISO 12006-2 and Uniclass)	Table Parity
A	Form of information		36	Information	AIA Information Classification System	High
B	Subject disciplines		32	Services	AIA Information Classification System	Medium
			33	Disciplines	AIA Information Classification System	Medium
C	Management		31	Phases	CSI Project Resource Manual (PRM), CSC Manual of Practice, Total Cost Management Framework AACE	Medium
			34	Organisational roles	AIA Information Classification System	Medium
D	Facilities		11	Construction entities by function	IBC, ICC, UBC & other building code occupancy classifications, AICDS.	Medium
E	Construction entities		12	Construction entities by form		Medium
F	Spaces		13	Spaces by function	GSA & ICC space definitions, AICDS.	Medium
			14	Spaces by form		Medium
G	Elements for buildings		21	Elements (including designed elements)	UniFormat, ASTM E1557, UNIFORMAT II, various ASTM 'format' documents.	Medium
H	Elements for civil engineering works					
J	Work sections for buildings	CAWS	22	Work results	Masterformat 2004 Edition	Low
K	Work sections for civil engineering works	CESMM3*				
L	Construction product	EPIC	23	Products	EPIC, Masterformat	High
M	Construction aids		35	Tools	AIA Information Classification System	Medium
N	Properties and characteristics		49	Properties	ISO 31-0, BS 6100, EPIC, IEEE/ASTM SI 10-1997, CI/SfB Construction Indexing Manual, IAI-NA Project Management Domain Specification project	Medium
P	Materials		41	Materials	EPIC, CI/SfB Construction Indexing Manual	Medium
Q	Universal Decimal Classification (UDC)	UDC				None

Acronym key: AACE = American Society of Civil Engineers AIA = American Institute of Architects AICDS = Appraisal Institute Commercial Data Standards ASTM = American Society for Testing and Materials CAWS = Common Arrangement of Works for building works CESMM3 = Civil Engineering Standard Method of Measurement, 3rd Edition CSC = Construction Specifications Canada CSI = Construction Specifications Institute EPIC = European Product Information Cooperation GSA = general Services Administration IBC = International Building Code ICC = International Code Council UBC = Universal Building Code

Medium Parity: **Generally means the tables have similar content, but they are arranged in a different order. Omniclass has more comprehensive listings of subjects.**

8 APPENDIX D: UNICLASS AND OMNICLASS TABLES

8.1 UNICLASS TABLES

Below is a full list of tables in Uniclass.

A Form of information

B Subject disciplines

C Management

D Facilities

E Construction entities

F Spaces

G Elements for buildings

H Elements for civil engineering works

J Work sections for buildings

K Work sections for civil engineering works

L Construction products

M Construction aids

N Properties and characteristics

P Materials

Q Universal Decimal Classification (UDC)

8.2 OMNICLASS TABLES

Below is a full list of Tables in Omniclass, released in 2006, showing their status.

Table	Status
Table 11 - Construction Entities by Function	Released
Table 12 - Construction Entities by Form	Released
Table 13 - Spaces by Function	Released
Table 14 - Spaces by Form	Released
Table 21 - Elements (includes Designed Elements)	Conditional Draft
Table 22 - Work Results	Released
Table 23 - Products	Draft
Table 31 - Phases	Released
Table 32 - Services	Released
Table 33 - Disciplines	Released
Table 34 - Organizational Roles	Released
Table 35 - Tools	Draft
Table 36 - Information	Draft
Table 41 - Materials	Released
Table 49 - Properties	Draft

9 APPENDIX E: WORK SECTION TABLES FROM UNICLASS, OMNICLASS AND NATSPEC

9.1 UNICLASS

Table J - Work sections for buildings (concise form)		Table K - Work sections for civil engineering works (concise form)	
JA	Preliminaries/General conditions	KA	General items
JB	Complete buildings/structures/units	KB	Ground investigation
JC	Existing site/buildings/services	KC	Geotechnical and other specialist processes
JD	Groundwork	KD	Demolition and site clearance
JE	In situ concrete/Large precast concrete	KE	Earthworks
JF	Masonry	KF	In situ concrete
JG	Structural/Carcassing metal/timber	KG	Concrete ancillaries
JH	Cladding/Covering	KH	Precast concrete
		KI	Pipework – pipes
JJ	Waterproofing	KJ	Pipework – fittings and valves
JK	Linings/Sheathing/Dry partitioning	KK	Pipework – manholes and pipework ancillaries
JL	Windows/Doors/Stairs	KL	Pipework – laying and excavation ancillaries
JM	Surface finishes	KM	Structural metalwork
JN	Furniture/Equipment	KN	Miscellaneous metalwork
		KO	Timber
JP	Building fabric sundries	KP	Piles
JQ	Paving/Planting/Fencing/Site furniture	KQ	Piling ancillaries
JR	Disposal systems	KR	Roads and paving
JS	Piped supply systems	KS	Rail track
JT	Mechanical heating/Cooling/Refrigeration systems	KT	Tunnels
JU	Ventilation/Air conditioning systems	KU	Brickwork, blockwork and masonry
JV	Electrical supply/power/lighting systems	KV	Painting
JW	Communications/Security/Safety/protection systems	KW	Waterproofing
JX	Transport systems	KX	Miscellaneous work
JY	General engineering services	KY	Sewer renovation and ancillary work
JZ	Building fabric reference specification	KZ	Simple building works

9.2 OMNICLASS

9.2.1 Table 22 – Work Results – Table of Contents

22-01 00 00 General requirements

22-02 00 00 Existing Conditions

22-03 00 00 Concrete

22-04 00 00 Masonry

22-05 00 00 Metals

22-06 00 00 Wood, Plastics, and Composites

22-07 00 00 Thermal and Moisture Protection

22-08 00 00 Openings

22-09 00 00 Finishes

22-10 00 00 Specialties

22-11 00 00 Equipment

22-12 00 00 Furnishing

22-13 00 00 Special Construction

22-14 00 00 Conveying Equipment

22-21 00 00 Fire Suppression
22-22 00 00 Plumbing
22-23 00 00 Heating, Ventilating, and Air - Conditioning (HVAC)
22-25 00 00 Integrated Automation
22-26 00 00 Electrical
22-27 00 00 Communications
22-28 00 00 Electronic Safety and Security
22-31 00 00 Earthwork
22-32 00 00 Exterior Improvements
22-33 00 00 Utilities
22-34 00 00 Transportation
22-35 00 00 Waterway and Marine Construction
22-40 00 00 Process Integration
22-41 00 00 Material Processing and Handling Equipment
22-42 00 00 Process Heating, Cooling, and Drying Equipment
22-43 00 00 Process Gas and Liquid Handling, Purification, and Storage Equipment
22-44 00 00 Pollution Control Equipment
22-45 00 00 Industry – Specific Manufacturing Equipment
22-48 00 00 Electrical Power Generation

9.3 NATSPEC worksection classification list

00 PLANNING AND DESIGN (AUS-SPEC)

0011 Development and subdivision of land
0012 Waterfront development
0013 Bushfire protection
0021 Site regrading
0041 Geometric road layout
0042 Pavement
0043 Subsurface drainage (Design)
0044 Pathways and cycleways
0061 Bridges and other structures
0071 Water supply - reticulation and pump stations (Design)
0074 Stormwater drainage (Design)
0075 Control of erosion and stormwater management
0076 Sewerage systems - reticulation and pump stations (Design)

01 GENERAL

0111 Specification cover sheet
0112 Tendering cover sheet
0113 Amendment sheet
0115 Referenced documents
0120 Information for tenderers (AUS-SPEC)
0121 Tendering
0121 Conditions of tendering (AUS-SPEC)
0122 Tendering (Interior and alterations)
0123 Tender submission documents (AUS-SPEC)
0130 Contract preparation model (AUS-SPEC)
0131 Preliminaries (Generic)
0133 Preliminaries (Generic interior and alterations)
0138 Multiple contracts
0141 Preliminaries - ABIC MW-1
0142 Preliminaries - ABIC SW-1
0143 Preliminaries - AS 2124
0144 Preliminaries - AS 4000
0145 Preliminaries - AS 4905
0146 Preliminaries - AS 4902
0147 Conditions of contract (AUS-SPEC)
0152 Schedule of rates – supply projects (AUS-SPEC)
0153 Schedules - period supply and service (AUS-SPEC)
0154 Contract schedules for parks and recreation areas (AUS-SPEC)
0155 Contract schedules for buildings and facilities (AUS-SPEC)
0156 Contract schedules for road reserves (AUS-SPEC)
0160 Quality (Design) (AUS-SPEC)
0161 Quality (NATSPEC)
0161 Quality (Construction) (AUS-SPEC)
0162 Supply quality plan (AUS-SPEC)
0163 Contractors quality plan (AUS-SPEC)
0164 Parks and recreation area management plan (AUS-SPEC)
0165 Buildings and facilities maintenance plan (AUS-SPEC)
0166 Road reserve management plan requirements (AUS-SPEC)
0169 Green star – office as built submissions
0171 General requirements
0172 General requirements (Interior and alterations)
0173 General requirements (Mechanical)
0174 General requirements (Hydraulic)
0175 General requirements (Electrical)
0176 Technical specification for supply (AUS-SPEC)

APPENDIX E: TABLES FROM UNICLASS, OMNICLASS & NATSPEC

0177 Technical specification for service (AUS-SPEC)
0179 General requirements (Construction) (AUS-SPEC)
0181 Adhesives, sealants and fasteners
0182 Fire-stopping
0183 Metals and prefinishes
0184 Termite management
0185 Timber finishes and treatment
0186 Building IT components

02 SITE

0201 Demolition
0202 Demolition (Interior and alterations)
0221 Site management
0222 Earthwork
0223 Service trenching
0224 Stormwater - site
0240 Landscape - gardening
0241 Landscape - walling and edging
0242 Landscape - fences and barriers
0243 Landscape – water features
0250 Landscape - gardening
0251 Landscape - soils
0252 Landscape - soft surfaces
0253 Landscape - planting
0254 Irrigation
0255 Landscape – plant procurement
0256 Landscape – establishment
0257 Landscape - roadworks and street trees (AUS-SPEC)
0261 Landscape - furniture and fixtures
0271 Pavement base and subbase
0272 Asphaltic concrete
0273 Sprayed bituminous surfacing
0274 Concrete pavement
0275 Segmental pavers - mortar bed
0276 Segmental pavers - sand bed
0277 Pavement ancillaries
0281 Bushfire perimeter tracks (AUS-SPEC)
0292 Masonry walls (AUS-SPEC)
0293 Crib retaining walls (AUS-SPEC)

03 STRUCTURE

0301 Piling
0310 Concrete – combined
0311 Concrete formwork
0312 Concrete reinforcement
0313 Concrete post-tensioned
0314 Concrete in situ
0315 Concrete finishes
0316 Precast concrete
0317 Tilt-up concrete
0318 Shotcrete
0319 Minor concrete works (AUS-SPEC)
0321 Monolithic stabilised earth walling
0322 Earth block walling
0323 Straw bale
0331 Brick and block construction
0332 Stone masonry
0333 Stone repair
0334 Block construction
0335 Brick construction
0341 Structural steel
0342 Light steel framing
0343 Tensioned membrane structures
0344 Steel - hot dip galvanized coatings
0345 Steel - protective paint coatings
0346 Structural fire protection systems
0381 Structural timber
0382 Light timber framing
0383 Flooring and decking

04 ENCLOSURE

0411 Waterproofing - external and tanking
0421 Roofing - combined
0423 Roofing - profiled sheet metal
0424 Roofing - seamed sheet metal
0425 Roofing - shingles and shakes
0426 Roofing - slate
0427 Roofing - tiles
0431 Cladding - combined
0432 Curtain walls
0433 Stone cladding
0434 Cladding - panels
0435 Cladding - planks
0436 Cladding - profiled sheet metal
0437 Cladding - sheet and pre-assembled systems
0451 Windows and glazed doors
0452 Window hardware
0453 Doors and hatches
0454 Overhead doors
0455 Door hardware
0456 Louvre windows
0457 External screens
0461 Glazing
0462 Structural glazing
0463 Glass blockwork
0467 Glass components
0471 Insulation and sarking membranes
0472 Acoustic insulation

05 INTERIOR

0511 Lining
0521 Partitions - demountable
0522 Partitions - framed and lined
0523 Partitions - brick and block
0524 Partitions - glazed
0525 Cubicle systems
0526 Terrazzo precast
0527 Room dividers
0531 Suspended ceilings - combined
0532 Suspended ceilings - flushed lined
0533 Suspended ceilings - panel systems
0534 Suspended ceilings - tiled
0541 Access floors
0551 Joinery
0552 Metalwork
0553 Stainless steel benching

APPENDIX E: TABLES FROM UNICLASS, OMNICLASS & NATSPEC

0554 Stairs, ladders and walkways
0571 Workstations
0572 Miscellaneous furniture
0573 Extinguishers and blankets
0574 Window coverings
0575 Tapestries
0581 Signs and display

06 FINISH

0611 Plastering
0612 Cementitious toppings
0613 Terrazzo in situ
0621 Waterproofing - wet areas
0631 Ceramic tiling
0632 Stone and terrazzo tiling
0641 Applied wall finishes
0651 Resilient finishes
0652 Carpets
0654 Engineered panel flooring
0655 Timber flooring
0656 Floor sanding and finishing
0657 Resin based seamless flooring
0671 Painting
0672 Textured and membrane coatings
0673 Powder coatings
0679 Wall papering

07 MECHANICAL

0701 Mechanical general requirements
0702 Mechanical design and install
0711 Chillers - combined
0712 Water heating boilers
0713 Cooling towers
0714 Mechanical pumps
0715 Tanks and vessels
0716 Chillers – centrifugal
0717 Chillers – water cooled screw
0718 Chillers – air cooled screw and scroll
0721 Packaged airconditioning
0722 Room airconditioners
0723 Evaporative coolers
0724 Air handling plant - combined
0725 Air handling plant - built up
0726 Air handling plant - minor
0727 Air handling plant - packaged
0731 Fans
0732 Air filters
0733 Air coils
0734 Humidifiers
0741 Ductwork
0744 Ductwork insulation
0745 Attenuators and acoustic louvres
0746 Air grilles
0747 Variable air volume terminals
0751 Mechanical piping
0752 Mechanical piping insulation
0753 Water treatment
0754 Liquid fuels
0755 Medical gas systems
0771 Automatic controls
0772 Automatic controls - minor
0773 Building management systems
0781 Mechanical electrical
0782 Mechanical electrical - minor
0784 Motors and starters
0791 Mechanical commissioning
0792 Mechanical maintenance

08 HYDRAULIC

0801 Hydraulic general requirements
0802 Hydraulic design and install
0811 Sanitary fixtures
0812 Tapware
0813 Water heaters
0814 Hydraulic pumps
0821 Stormwater - buildings
0822 Wastewater
0823 Cold and heated water
0824 Fuel gas
0825 Rainwater storage systems
0831 Hydrants
0832 Hose reels
0833 Sprinklers

09 ELECTRICAL

0901 Electrical general requirements
0902 Electrical design and install
0911 Cable support and duct systems
0921 Low voltage power systems
0931 Power generation -diesel
0933 Power generation - photovoltaic
0937 Uninterruptible power supply
0941 Switchboards - proprietary
0942 Switchboards - custom-built
0943 Switchboard components
0947 Power factor correction
0951 Lighting
0952 Luminaires - custom-built
0961 Telecommunications cabling
0962 Television distribution systems
0971 Emergency evacuation lighting
0972 Fire detection and alarms
0973 Emergency warning and intercommunication
0979 Lightning protection
0981 Electronic security

11 CONSTRUCTION - ROADWAYS (AUS-SPEC)

1101 Control of traffic
1102 Control of erosion and sedimentation
1111 Clearing and grubbing
1112 Earthworks (Roadways)
1113 Stabilisation
1121 Open drains, including kerb and channel gutter
1122 Kerb and channel gutter replacement

APPENDIX E: TABLES FROM UNICLASS, OMNICLASS & NATSPEC

1131 Rolled concrete subbase
1132 Mass concrete subbase
1133 Plain and reinforced concrete base
1134 Steel fibre reinforced concrete base
1135 Continuously reinforced concrete base
1136 Cold milling of asphalt and base course
1141 Flexible pavements
1142 Bituminous cold mix
1143 Sprayed bituminous surfacing
1144 Asphaltic concrete (Roadways)
1145 Segmental paving
1146 Bituminous microsurfacing
1151 Road openings and restoration
1152 Road openings and restoration (Utilities)
1163 Rigid concrete and road safety barrier systems (Public domain)
1171 Subsurface drainage
1172 Subsoil and foundation drains
1173 Pavement drains
1174 Drainage mats
1191 Pavement markings
1192 Signposting
1193 Guide posts
1194 Non-rigid road safety barrier systems (Public domain)
1195 Boundary fences for road reserves

13 CONSTRUCTION – PUBLIC UTILITIES

1341 Water - reticulation and pump stations (Construction)
1351 Stormwater drainage (Construction)
1352 Pipe drainage
1353 Precast box culverts
1354 Drainage structures
1361 Sewerage systems- reticulation and pump stations (Construction)
1391 Service conduits
1392 Trenchless conduit installation

14 MAINTENANCE AND OPERATIONS - URBAN AND OPEN SPACES

1401 Technical specifications for parks and recreation areas
1411 Street landscaping
1412 Grass mowing in road reserves
1413 Tree and vegetation control in road reserves
1414 Weed control in road reserves
1415 Weed control
1416 Planting of annuals and trees
1417 Care of trees and shrubs
1418 Gardens
1419 Care of grass and turf
1420 Grass mowing
1421 Native bushland
1422 Dunal areas
1423 Pest control
1424 Landscape – maintenance (NATSPEC)
1431 Footpath paving repairs
1432 Gravel footpath repairs
1433 Footpath and kerb ramp repairs adjacent to roadways
1441 Bituminous surfacing repairs
1442 Boat ramps maintenance
1461 Swimming enclosures maintenance
1462 Boundary fence repair
1471 Barbecues maintenance
1472 Drinking fountains maintenance
1473 Fences, rails, racks, guards and barriers
1474 Lighting maintenance
1475 Playground equipment maintenance
1476 Park furniture maintenance
1477 Sports ground facilities maintenance
1481 Accident repairs (Recoverable)
1482 Accident repairs (Non-recoverable)
1483 Emergency call out
1484 Storm damage response
1491 Open space litter collection
1492 Open space graffiti removal

15 MAINTENANCE AND OPERATIONS - BUILDINGS

1501 Technical specifications for buildings and facilities
1531 Floors
1532 Walls
1533 Doorways and windows
1534 Ceilings
1535 Roofing
1571 Mechanical systems
1572 Hydraulic systems
1573 Electrical systems
1581External building surveillance
1582 Accident repairs management (Recoverable)
1583 Emergency call out
1584 Storm damage response
1585 External cleaning
1586 Internal cleaning
1587 Sanitary cleaning
1588 Windows cleaning
1589 Cleaning - blinds and fire proofing of curtains

16 MAINTENANCE AND OPERATION - ROADWAYS

1601Technical specifications for road reserves
1611 Pavement sweeping
1612 Auxiliary work for reseals
1613 Repairs to bituminous surfacing
1614 Crack sealing
1615 Local shape correction
1616 Grading unsealed roads
1617 Resheeting unsealed roads
1618 Heavy patching
1619 Minor patching
1620 Pothole repair
1621 Concrete pavement repairs
1622 Concrete slab stabilization
1623 Emergency pavement repairs
1631 Edge break repair
1632 Grading unsealed shoulders
1633 Resheeting unsealed shoulders
1634 Local scour repair
1641 Kerb and channel gutter repairs

APPENDIX E: TABLES FROM UNICLASS, OMNICLASS & NATSPEC

1642 Traffic islands
1651 Clear roadway subsoil drains
1652 Clear road reserve open drains
1671 Road reserve boundary fence repair
1672 Road reserve fences and handrails
1673 Street seats and bus shelters
1674 Carriageway delineators
1675 Roadway guard fence
1676 Road reserve regulatory, warning and standard signs
1677 Road reserve guide signs
1681 Accident repairs (Recoverable)
1682 Road reserve emergency call out
1683 Storm damage response for road safety
1684 Traffic facilities - Road traffic control
1691 Road reserve litter collection
1692 Removal of graffiti visible from roads

17 MAINTENANCE AND OPERATIONS - BRIDGES

1701 Wharves and decks maintenance

18 MAINTENANCE AND OPERATIONS - PUBLIC UTILITIES

1841 Water supply - irrigation systems
1851 Clear open space and drains
1852 Clear open space drainage culverts
1853 Clear roadway culverts and pits
1854 Minor repair of road reserve lined drains
1881 Beach cleaning management

CORPORATE INFORMATION

NATSPEC is the trading name of Construction Information Systems Limited, ABN 20 117 574 606.

NATSPEC, founded in 1975, is a national not-for-profit organisation that is owned by the design, build, construct and property industry through professional associations and government property groups. It is impartial and is not involved in advocacy or policy development.

NATSPEC's major service is the provision of the comprehensive national specification systems endorsed by government and professional bodies. NATSPEC, the National Building Specification, is for all building structures, with specialist packages for architects, interior designers, landscape architects, structural engineers, service engineers and domestic owners. AUS-SPEC is the Local Government specification system for the life-cycle management of assets. Packages include Urban and Open Spaces, Roadworks and Bridges, Public Utilities, and Maintenance. NATSPEC is also the publisher of the National BIM Guide and associated documents.

NATSPEC's objective is to improve the construction quality and productivity of the built environmenet through the leadership of information.

STAKEHOLDERS

// Air Conditioning and Mechanical Contractors' Association of Australia
// Australian Council of Built Environment Design Professions
// Australian Elevator Association
// Australian Institute of Architects
// Australian Institute of Building
// Australian Institute of Building Surveyors
// Australian Institute of Quantity Surveyors
// Chief Minister, Treasury and Economic Development Directorate (ACT)
// Construction Industry Engineering Services Group
// Consult Australia
// Department of Finance (Federal)
// Department of Finance (WA)
// Department of Housing and Public Works (QLD)
// Department of Infrastructure (NT)
// Department of Planning, Transport and Infrastructure (SA)
// Department of Treasury and Finance (TAS)
// Department of Treasury and Finance (VIC)
// Engineers Australia
// Master Builders Australia
// Office of Finance and Services (NSW)
// Standards Australia

CONTACT INFORMATION

NATSPEC//

PHONE 1300 797 142
FAX 1300 797 143
EMAIL mail@natspec.com.au
WEB www.natspec.com.au

NATSPEC//ConstructionInformation