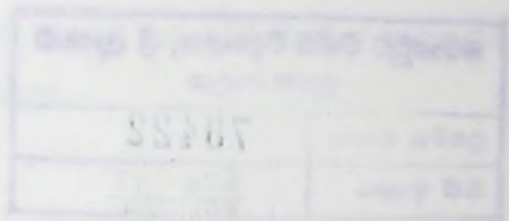


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A Hybrid Approach  
to the  
Representation and Processing  
of  
Design Standards



Avril I. Neilson B.Eng (Hons.)

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University of Strathclyde  
  
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## DECLARATION

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Glasgow

June 1997

Avril I. Neilson

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## ABSTRACT

This thesis presents an environment for the modelling and processing of structural design standards. This environment is known as SADA, an acronym for Standards Automated Design Assistant. SADA addresses many of the drawbacks conventionally associated with design standards and existing models of design standards. A study of existing standards models and design standards was carried out, which resulted in the identification of a number of key issues, including:

- structural design standards are ambiguous and are therefore subject to interpretation;
- structural design standards generally address standard or routine design contexts, existing standards models fail to recognise this;
- existing models are generally opaque in nature:
  - (i) it is not clear to the user how the standards have been modelled
  - (ii) processing of the standard is a 'black-box' activity, furthermore;
  - (iii) users have no control over the modelling or processing activities.

SADA consists of four main modules, each consisting of several components:

- Code Information Base;
- Processing Module;
- Dependency Network Generator;
- Design Case Base.

Each module performs its designated tasks contributing to the overall functionality of SADA. Numerous standards can be encapsulated and browsed in a hypertext manner within the SADA model. SADA supports the production of designs within the scope of the standards contained in the model. Standard and non-standard contexts are distinguished. A procedural approach is adopted for the production of standard or routine designs. Case Based support is provided for handling non-standard designs. A conformance checking facility is provided for designs produced within SADA, and independently. An applicability checking feature

ensures standards are not applied out of context. Various features giving the user control over the modelling and processing of the standards contained in SADA have been implemented.

Thanking my supervisor Dr. Kottava, I would like to thank my colleagues, the friends who have spent time with me during my PhD. I also thank my family and friends who have supported me during this journey. I am grateful to the people who have helped me in my journey. If I achieved a milestone I only hope I can be just a tiny bit like "Thank you so much".

I am very grateful to find a platform for my publications and my work. I have been very busy over the last few years.

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Everyone in the CAD Center for moral support during the long winter months. I know that it would be so much comforting to know that other people are having a hard time too.

My parents for making me what I am today.

With this, I am sure that you will be happy.

For the whole team who have helped me.

For the whole team who have helped me.

For the whole team who have helped me, and the faculty of engineering for providing me with the opportunity to study.



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Nods, Pug and Kit - sorry for neglecting you guys

DJ for almost keeping me sane

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EPSRC, the division of structural engineering, and the faculty of engineering for contributing towards my trip to the US.

## Terminology

**provision:** provisions are the smallest quantity of information found within a code i.e. the last classification division made in a code. The term *clause* has also been used in some existing work

**requirement:** a requirement imposes certain criteria or conditions upon a design. A requirement may be an entire provision or a subsection of a provision. Not all provisions contain requirements.

**data items:** data items are variables to which the standard refers within its text

**basic data items:** a data item for which no explicit expression is provided in the standard that defines its value, its value is obtained from the design being evaluated or from general knowledge of the domain

**derived data items:** a data item for which an explicit logical or mathematical expression for deriving its value is provided within the text of the standard

**Design Entity (DE):** the term design entity has been adopted to describe the object that is being designed.

**design context:** a design context is a description of a design in terms of its attributes.

**Code Limitation:** statements made within a code which place restrictions on the scope of its application

**standard design:** the term standard design is used to denote routine designs. For example, considering the design of reinforced concrete beams a standard design would be beams with a rectangular or flanged cross section.

**non-standard design:** the term non-standard design refers to non routine designs. Again consider the design of reinforced concrete beams a non-standard design would be a beam with an irregular cross section such as trapezoidal.

**module:** within the context of this thesis module refers to the various *top level* components of the SADA module i.e. Code Information Base, Processing Module etc.

**component:** refers to the various elements of each of SADA's modules i.e. Provision Retrieval Component, Conformance Checking Component.

## Abbreviations

WWW or Web	<u>W</u> orld <u>W</u> ide <u>W</u> eb.
SGML	<u>S</u> taridarised <u>G</u> eneral <u>M</u> ark-up <u>L</u> anguage.
HTML	<u>H</u> yper <u>T</u> ext <u>M</u> ark-up <u>L</u> anguage.
ES	<u>E</u> xpert <u>S</u> ystem
KBS	<u>K</u> nowledge <u>B</u> ase <u>S</u> ystem
CBR	<u>C</u> ase <u>B</u> ase <u>R</u> easoning
DNG	<u>D</u> ependency <u>N</u> etwork <u>G</u> enerator
CIB	<u>C</u> ode <u>I</u> nformation <u>B</u> ase
SADA	<u>S</u> tandards <u>A</u> utomated <u>D</u> esign <u>A</u> ssistant
CE	<u>C</u> ode <u>E</u> ntity
DE	<u>D</u> esign <u>E</u> ntity
CL	<u>C</u> ode <u>L</u> imitation
ULS	<u>U</u> ltimate <u>L</u> imit <u>S</u> tate
SLS	<u>S</u> erviceability <u>L</u> imit <u>S</u> tate