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Systèmes d'automatisation industrielle et intégration — Représentation et échange de données de produits —

Partie 209: Protocole d'application: Analyse structurelle composite et métallique et conception associée

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10303 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10303-209 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

This International Standard is organized as a series of parts, each published separately. The structure of this International Standard is described in ISO 10303-1.

Each part of this International Standard is a member of one of the following series: description methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integration application resources, application protocols, abstract tests suites, application interpreted constructs, and application modules.

This part is a member of the application protocol series.

A complete list of parts of ISO 10303 is available from the Internet:

<http://www.nist.gov/sc4/editing/step/titles/>.

Annexes A, B, C, D, and E form a normative part of this part of ISO 10303. Annexes F, G, H, J, and K are for information only.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases, and as a basis for archiving.

This part of ISO 10303 is a member of the application protocol series. This part of ISO 10303 specifies an application protocol (AP) for the exchange of computer-interpretable composite and metallic structural product definitions, including product shape, associated finite element analysis (FEA) models and analysis results, and the material properties of these products.

The shape of a composite or metallic product definition includes the part and its constituents, including any ply shapes necessary for FEA node and mesh generation of boundary definitions. This information is suitable for the automated generation of composite material properties and geometric properties for finite elements. The shape definitions for design and analysis are each independently configuration controlled.

The finite element model idealizes a product or aspects of a product so that it may be analyzed to validate the structural performance and structural integrity of a product.

Finite elements of homogenous (isotropic) metallic and adhesive material properties are treated in this part of ISO 10303 as a subset of anisotropic composite material response. The differences between these two material response idealizations are: 1) a simplified material response, and 2) having no associated composite constituent information.

Assembly information provides the relationships necessary to identify analysis boundary conditions, and when combined with part geometry, topology, and finite element analysis output, provides the input necessary for detail analyses such as those for fastened structural joints.

This part of ISO 10303 satisfies the need for exchange of information between the iterative design and analysis stages of the product life cycle. Product configuration information provides the audit trail necessary to control the designed shape, its associated finite element model, and any related analysis shape information during these iterative stages of the product life cycle.

This application protocol defines the context, scope, and information requirements for the exchange of the information necessary to perform the design through analysis stages of the life cycle of composite and metallic structural parts, and specifies the integrated resources necessary to satisfy these requirements.

Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. Clause 3 lists the words defined in this part of ISO 10303 and gives pointers to words defined elsewhere. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model, is given in annex G.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. The expanded listing given in annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex C.

Additionally, this application protocol enumerates the conformance requirements which identify the implementation options for the abstract test suite. This application protocol may be implemented as a whole, or as one of the allowed conformance classes. These conformance classes state the implementation options for the representation of finite element analysis models, controls and results, analysis reports, geometric models, composite material constituents and their representations, materials, and configuration control.

A high level planning information model for this application protocol is shown in Figure 1. At this level, the product can be conceptualized as a part that has both design and analysis product definitions. Each definition has one or more shape representations. The analysis product definition has an associated finite element model, analysis controls, and analysis results in addition to its shape representations.

The three possible product shape representations in this application protocol include the nominal design shape, an idealized analysis shape, and a finite element model node shape. The nominal design shape includes geometry and topology for the part and its constituents, such as ply boundaries. The idealized analysis shape includes only the geometry and topology for mesh generation boundaries and associated node geometry. The node shape includes only the node geometry, with no association to design shape or to analysis idealized shape.

The five types of geometric and topological models that may be used to represent part shape in this application protocol are: wireframe and surface without topology, wireframe geometry with topology, manifold surfaces with topology, faceted boundary representation, and advanced boundary representation.

The finite element analysis model consists of nodes, elements, and the associated element properties. The finite element properties include shape aspects and material properties.

The finite element analysis material properties are specified with respect to an environment. The material response matrices of the material properties may have an associated laminate table. The laminate table specifies the constituents, such as plies in a laminate. Each constituent has a boundary, stock material, and specifications. A separate geometric representation is used for composite material constituent representations.

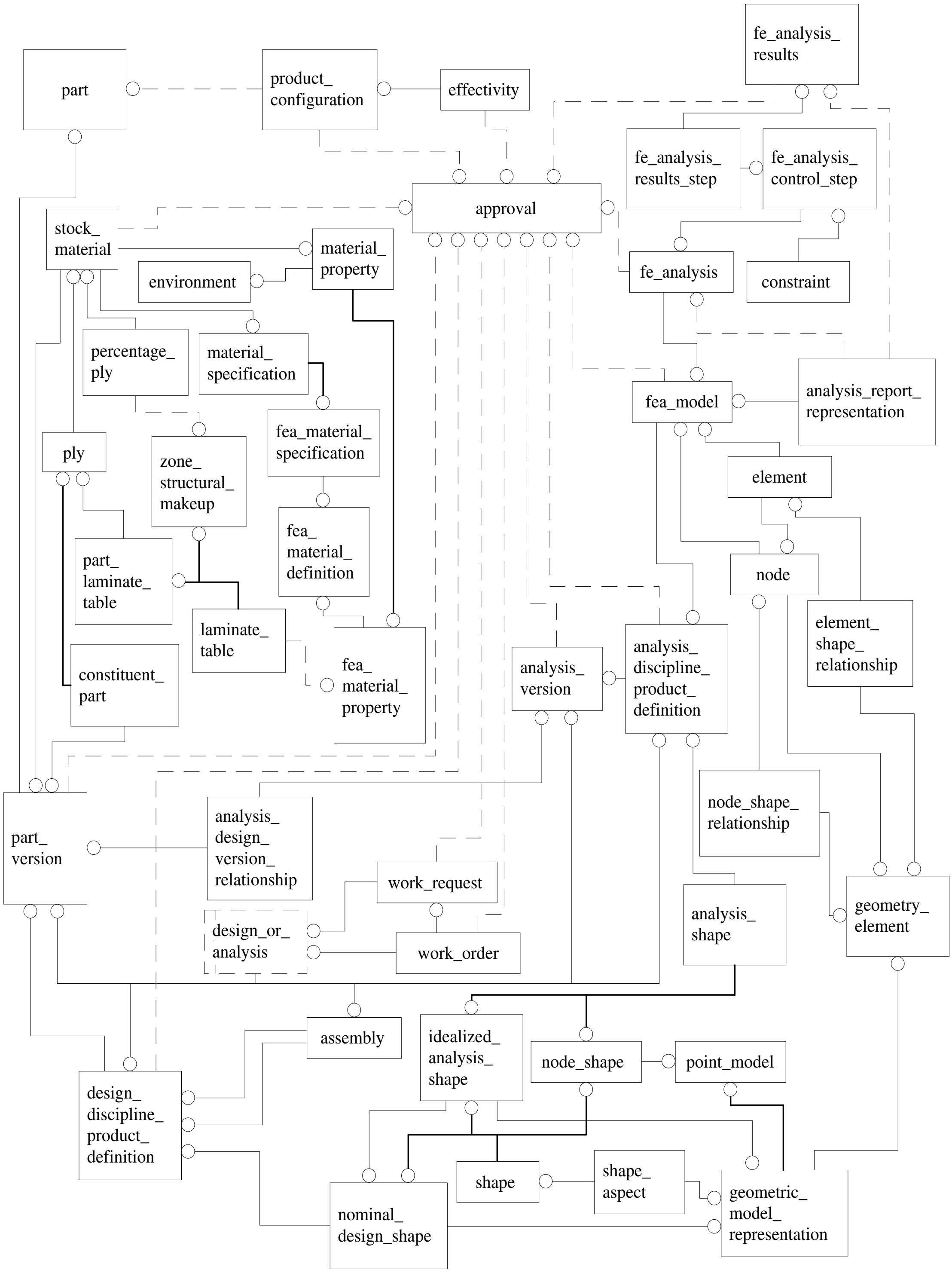

Figure 1 - Data planning model

The finite element analysis controls and results are associated with a finite element model. The analysis controls specify the operations to be carried out upon the model as a series of analysis steps. The analysis results specify the state of the analysis variables at an instant in time. The state information includes nodal solution variables such as deflections, the field variables within the elements, and the values of constraints at a node. An analysis report of the finite analysis results may be presented in tabular and graphical form. The analysis report also documents the detail analyses upon which the finite element analysis results are based.

