Automation (21-541)

Advanced Manufacturing Laboratory

Department of Industrial Engineering

Sharif University of Technology

Session # 11

Session Schedule

- *Computer-Aided Design (CAD)*
  - *Geometric modeling*
    - *Geometric data exchange*

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Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *The heart of any CAD model is the component database.*

  This includes

  - *The graphics entities like points, lines, arcs, circles etc. and the co-ordinate points, which define the location of these entities.*
  - *This geometric data is used in all downstream applications of CAD, which include*
    - *Finite element modeling and analysis,*
    - *Process planning,*
    - *Estimation,*
    - *CNC programming,*
    - *Robot programming,*
    - *Programming of co-ordinate measuring machines,*
    - *ERP system programming and simulation.*

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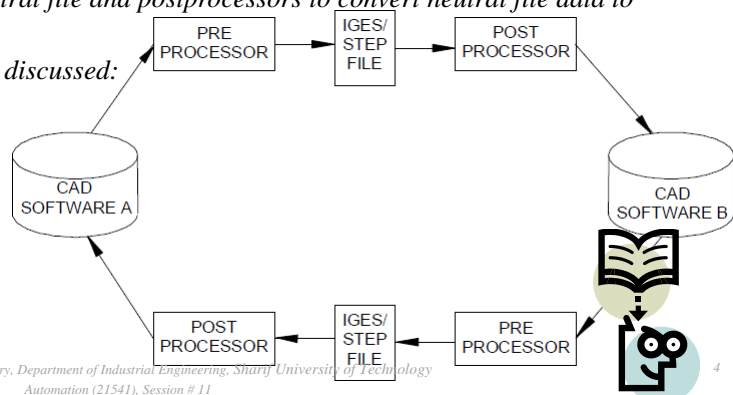*Automation (21541), Session # 11*

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Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *A solution to the problem of direct translators is to use neutral files.*
  - *These neutral files will have standard formats and software packages can have pre-processors to convert drawing data to neutral file and postprocessors to convert neutral file data to drawing file.*
  - *Three types of neutral files are discussed:*
    - *Drawing exchange files (DXF)*
    - *IGES files*
    - *STEP files*

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Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Standard for the Exchange of Product data (STEP, ISO 10303):*

    - *The STEP is the enabler for seamless exchange of product data which is critical to CAD/CAM/CAE systems.*

    - *STEP itself is the basis for Product Data Management System (PDM).*

    - *It covers border functionalities. It includes methods of representing all critical product specifications such as*
      - *Shape information,*
      - *Materials,*
      - *Tolerances,*
      - *Finishes and*
      - *Product structure.*

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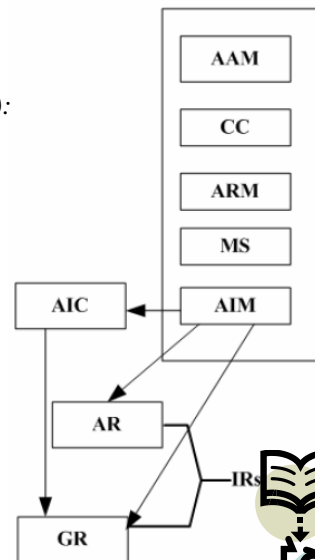*Automation (21541), Session # 11*

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Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Standard for the Exchange of Product data (STEP, ISO 10303):*

Initial STEP Architecture


```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION(
/* description */ ('A minimal AP214 example with a single part'),
/* implementation_level */ '2;1');
FILE_NAME(
/* name */ 'demo',
/* time_stamp */ '2003-12-27T11:57:53',
/* author */ ('Lothar Klein'),
/* organization */ ('LKSoft'),
/* preprocessor_version */ ' ',
/* originating_system */ 'IDA-STEP',
/* authorization */ ' ');
FILE_SCHEMA (('AUTOMOTIVE_DESIGN { 1 0 10303 214 2 1 1}'))
ENDSEC;
DATA;
#10=ORGANIZATION('O0001','LKSoft','company');
#11=PRODUCT_DEFINITION_CONTEXT('part definition',#12,'manufacturing');
#12=APPLICATION_CONTEXT('mechanical design');
#13=APPLICATION_PROTOCOL_DEFINITION(,'automotive_design',2003,#12);
#14=PRODUCT_DEFINITION('0',$,#15,#11);
#15=PRODUCT_DEFINITION_FORMATION('1',$,#16);
#16=PRODUCT('A0001','Test Part 1','',(#18));
#17=PRODUCT_RELATED_PRODUCT_CATEGORY('part',$,(#16));
#18=PRODUCT_CONTEXT('',#12,'');
#19=APPLIED_ORGANIZATION_ASSIGNMENT(#10,#20,(#16));
#20=ORGANIZATION_ROLE('id owner');
ENDSEC;
END-ISO-10303-21;
```

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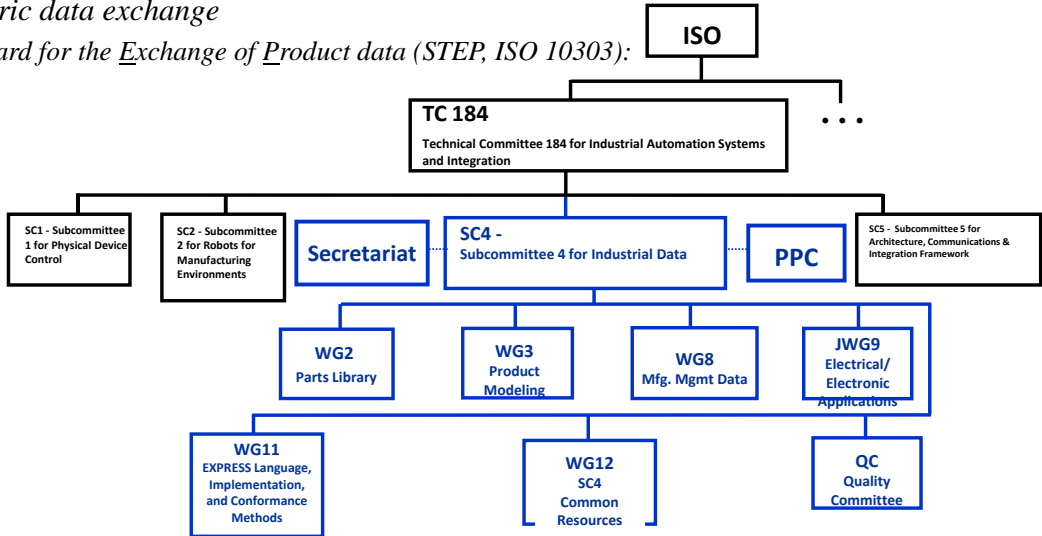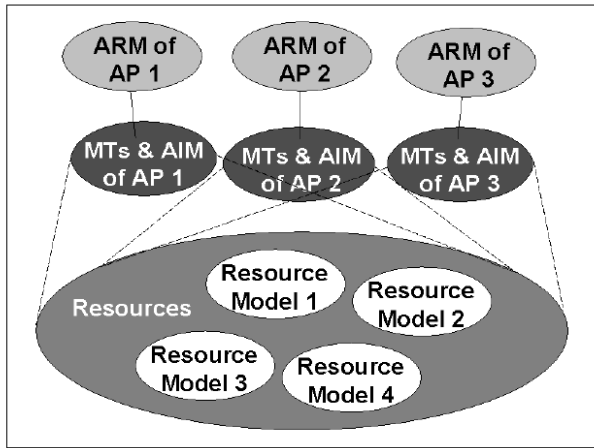*Automation (21541), Session # 11*

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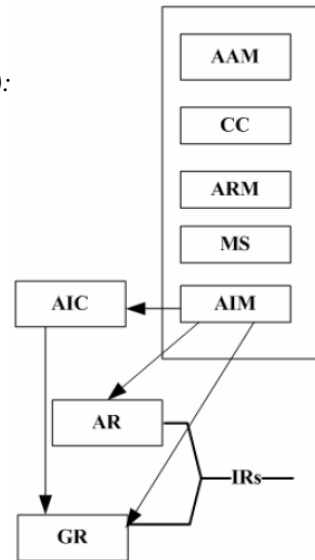# *Computer-Aided Design (CAD)*

- *Geometric data exchange*
  - *Standard for the <u>E</u>xchange of <u>P</u>roduct data (STEP, ISO 10303):*

ISO

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TC 184

Technical Committee 184 for Industrial Automation Systems and Integration

| SC1 - Subcommittee 1 for Physical Device Control | SC2 - Subcommittee 2 for Robots for Manufacturing Environments | **Secretariat** | **SC4 -** Subcommittee 4 for Industrial Data | **PPC** | SC5 - Subcommittee 5 for Architecture, Communications & Integration Framework |

WG2
Parts Library

WG3
Product Modeling

WG8
Mfg. Mgmt Data

JWG9
Electrical/
Electronic
Applications

WG11
EXPRESS Language,
Implementation,
and Conformance
Methods

WG12
SC4
Common
Resources

QC
Quality
Committee

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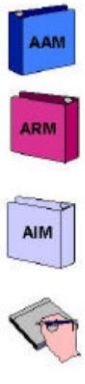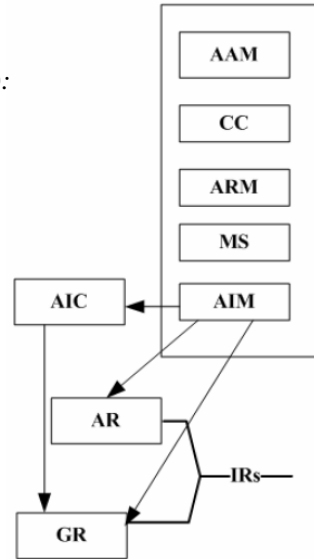*Automation (21541), Session # 11*

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Computer-Aided Design (CAD)

Initial STEP Architecture

- *Geometric data exchange*
  - *Standard for the <u>E</u>xchange of <u>P</u>roduct data (STEP, ISO 10303):*

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Computer-Aided Design (CAD)

- *Geometric data exchange*
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Initial STEP Architecture

Contents of an Application Protocol

◆Application Activity Model

A function model that describes the activities and processes of defined application context domain. This is a requirement document.

◆Application Reference Model

An information model that describes the information requirements and constraints for an application context area. The model uses application-specific terminology and rules that are familiar to experts in the application area.

◆Application Interpreted Model

An information model that describes the STEP data structures required for functional equivalence with the application contexts' AAM's and ARM's.

◆Conformance Classes

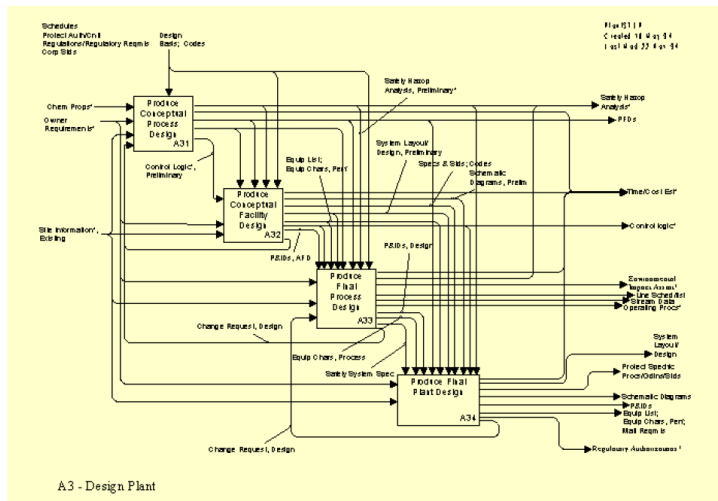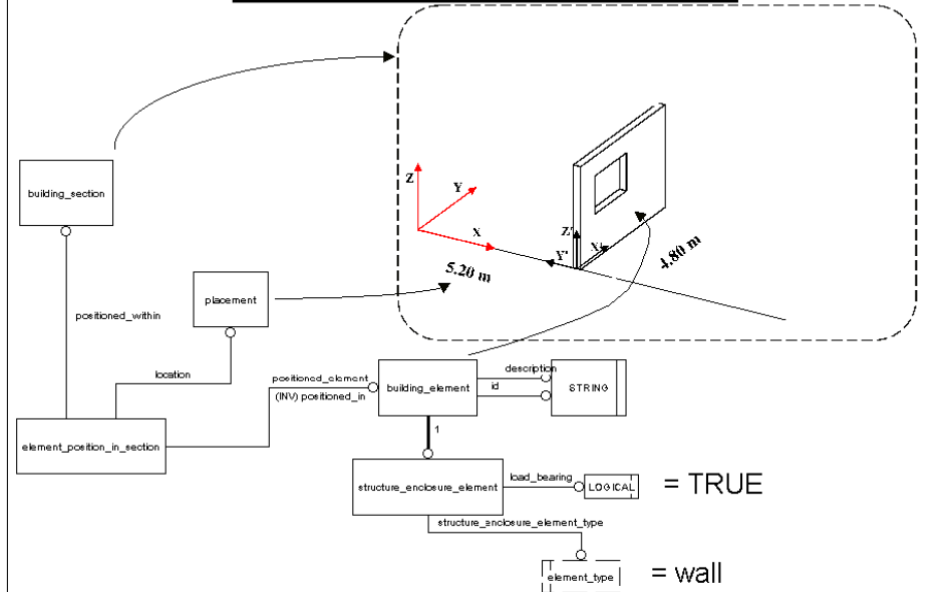Descriptions of the valid populations of the file, which serve to define conformant uses of the AP.

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Application Activity Model (AAM)

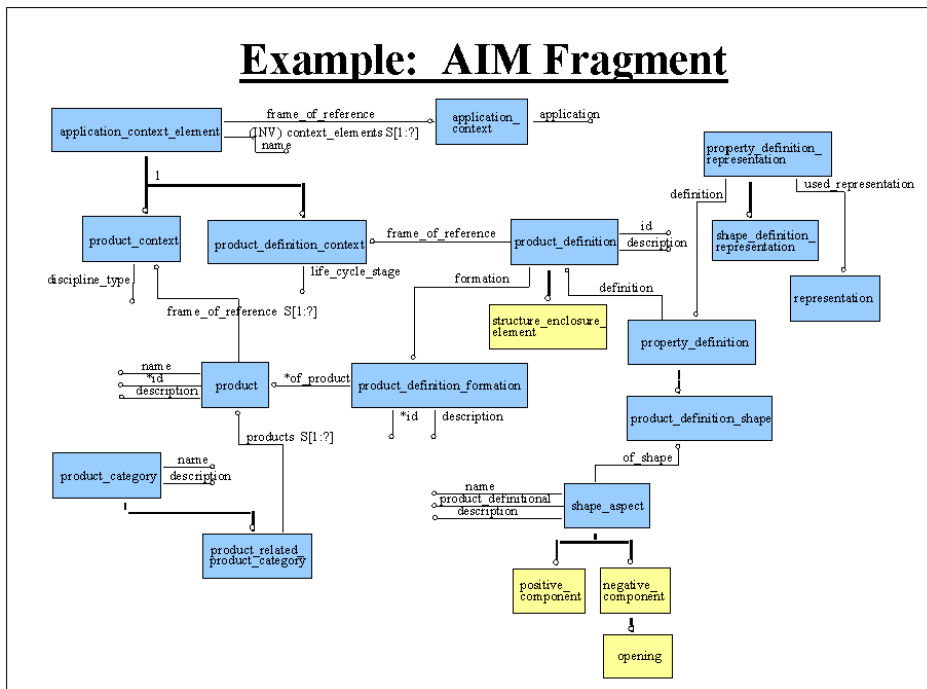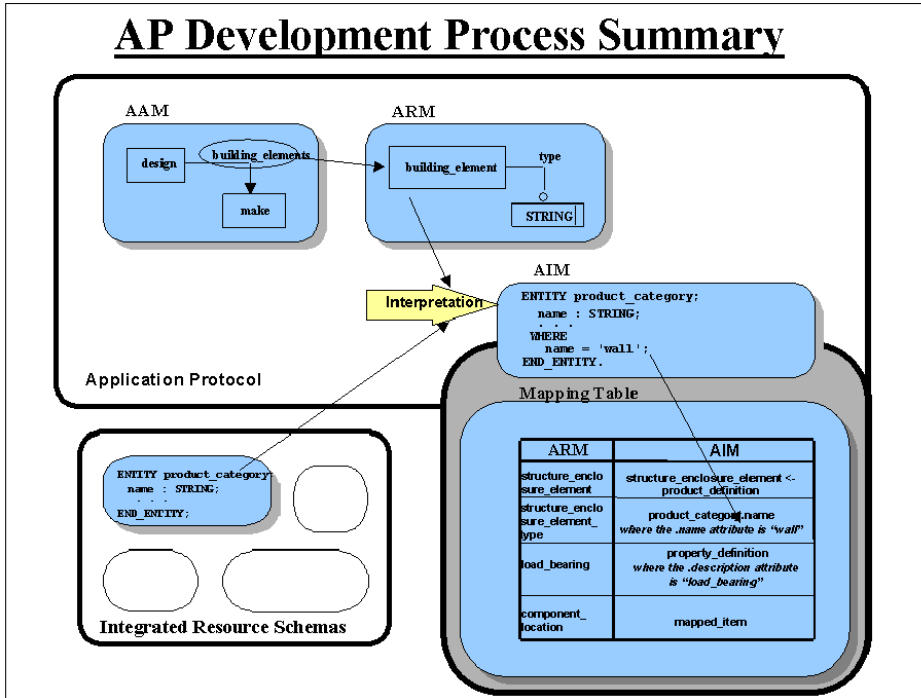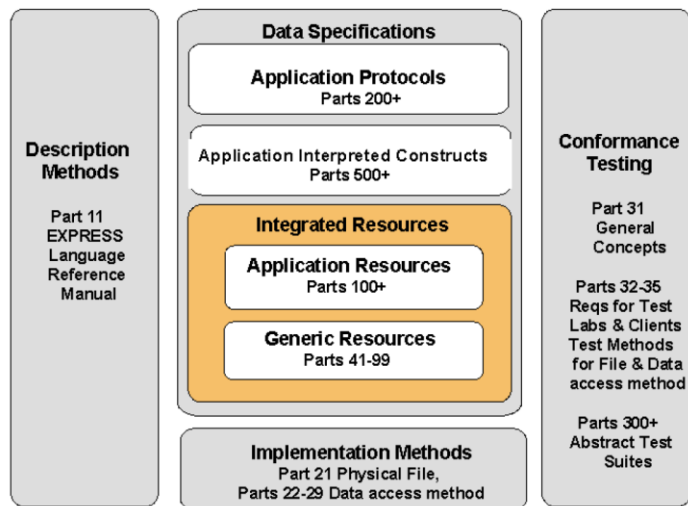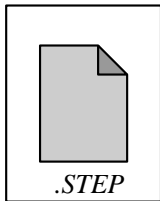Information "flows" between activities are the basis for development of ARM.

A3 - Design Plant

Example: ARM Relationship to Information Requirements

building_section

positioned_within

placement

location

5.20 m

4.80 m

positioned_element
(INV) positioned_in

element_position_in_section

building_element

description

id

STRING

structure_enclosure_element

load_bearing

LOGICAL

= TRUE

structure_enclosure_element_type

element_type

= wall

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Example: AIM Fragment

application_context_element

frame_of_reference

(INV) context_elements S[1:?]

name

application_context

application

property_definition_representation

product_context

product_definition_context

frame_of_reference

product_definition

id

description

definition

used_representation

shape_definition_representation

discipline_type

life_cycle_stage

formation

definition

representation

frame_of_reference S[1:?]

structure_enclosure_element

property_definition

name
*id
description

product

*of_product

product_definition_formation

*id

description

product_definition_shape

products S[1:?]

of_shape

product_category

name
description

name
product_definitional
description

shape_aspect

product_related_product_category

positive_component

negative_component

opening

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.STEP

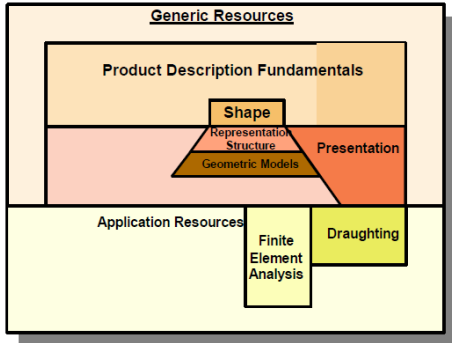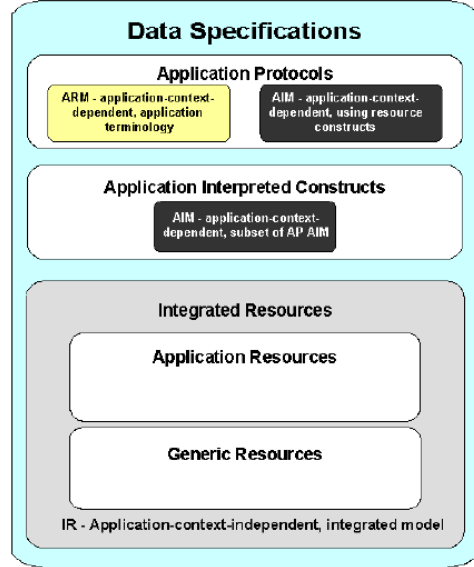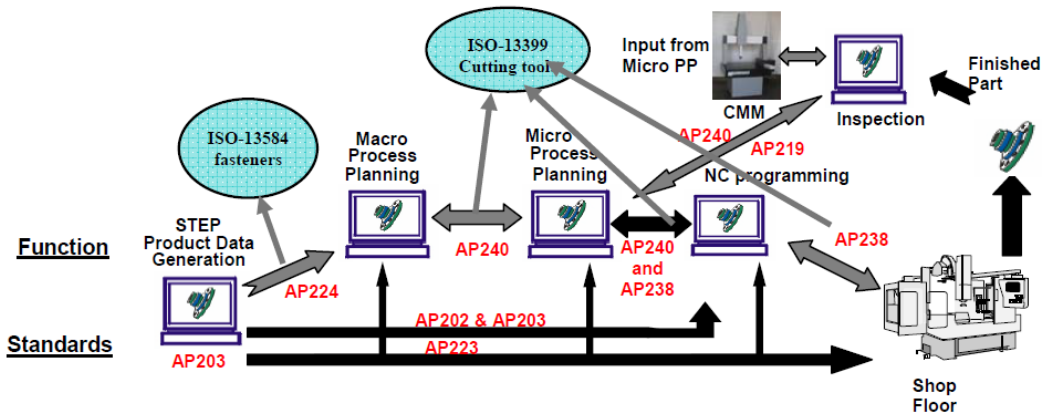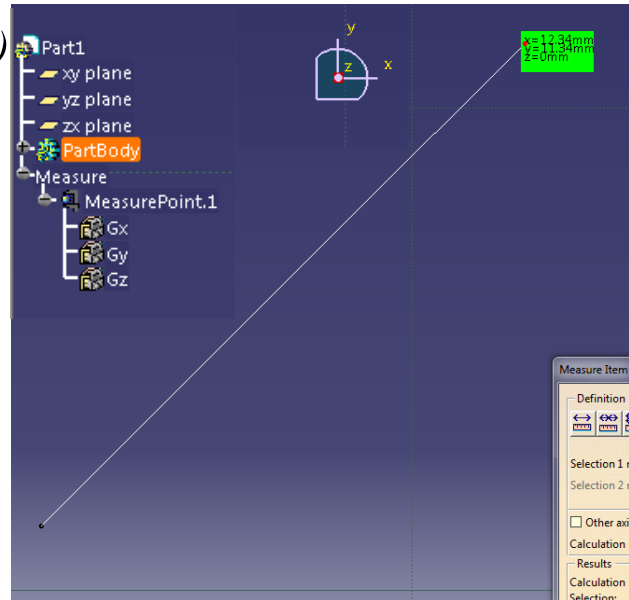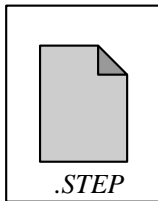Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
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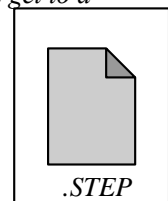
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Homework: AT-G-08-#

- *In this HW you will try to analyze a simple example of STEP standard Integrated Resources (IRs):*
  - *Consider the following STEP file*

  - *Start from the "Cartesian_Point " entity and draw a simple Entity model till you get to a B-Rep model.*

.STEP

- *The HW should be sent to FValilai@sharif.edu till Saturday, 10th of khordad (May, 31st ,2014)*
- *Email subject: "AT-G-08-#"*

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