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Technical Requirements Specification

ITER Coordinate Systems

This document describes the Coordinate Systems used on ITER Site with the definition of the origin and naming. All Coordinates used in the ITER Project shall conform to the requirements of this document.

<i>Approval Process</i>			
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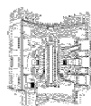
The Way to Fusion Energy

ITER COORDINATE SYSTEMS

Abstract

This document describes the Coordinate Systems used on ITER Site with the definition of the origin, orientation and naming. All Coordinates used in the ITER Project shall conform to the requirements of this document.

	IDM Number: ITER_D_2A9PXZ v3.7	Date: 03 April 2008
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The Way to Fusion Energy

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Scope

The coordinate systems defined for the ITER Project are the “Tokamak Global Coordinate System” and a number of “Local Coordinate Systems”. Reference is also made to the French “Lambert III” and “NGF-IGN69” systems.

The “Tokamak Global Coordinate System” defines the location of all systems and components in the Tokamak Complex and is the reference system for the whole of the ITER site.

The “Local Coordinate Systems” are defined for each building or area on the ITER Site. Local Coordinate Systems allow individual buildings or areas to be defined without reference to the whole site.

This document describes the inter-relationship and use of these coordinate systems.

1 French Coordinate System “Lambert Conic Projection”

The French Coordinate System “Lambert Conic Projection” is used for the survey of the ITER Site. For minimization of deformations France is divided into four areas called Lambert I, Lambert II, Lambert III and Lambert IV (see Figure 1). To determine a point altimetry, a network of levelling points distributed over the territory is used. This network is called NGF-IGN69 (NGF = French General Levelling).

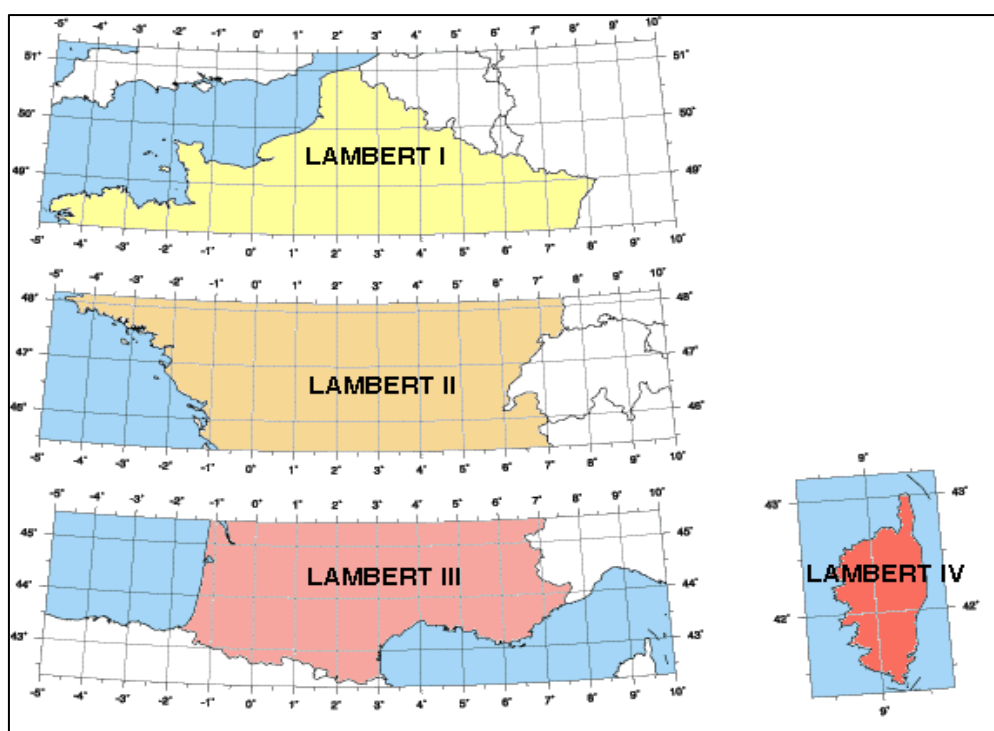
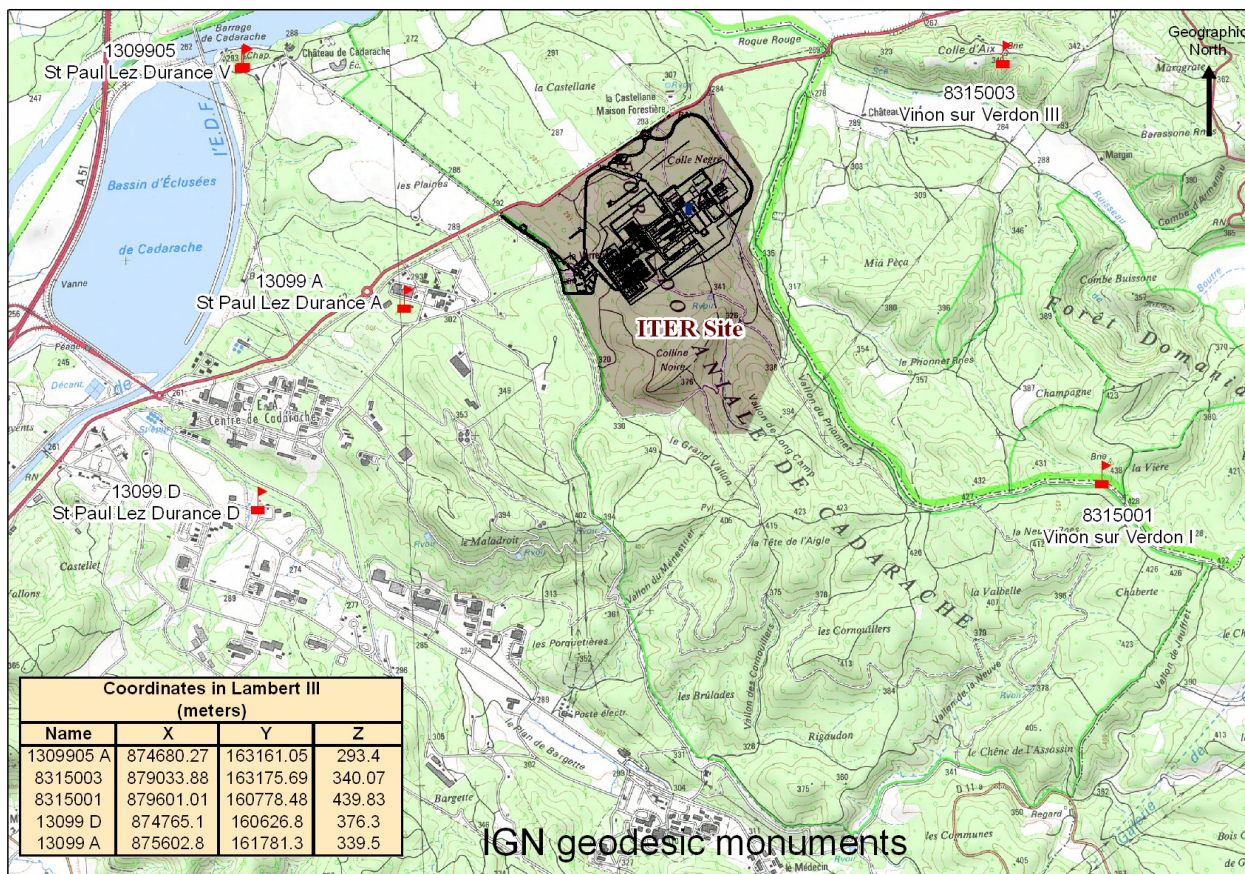


Figure 1 : Lambert Coordinate Systems

All over France, there are geodesic monuments, maintained by IGN (National Geographical Institute) which are used as reference for all survey works. Their location and coordinates (X-Y-Z) are available on the web. The statutory coordinates system on ITER area is the LAMBERT III system for (X,Y) and NGF-IGN69 for altimetry (Z).

The referenced IGN monuments in the immediate surroundings of the ITER Site are shown on the following figure :



2 ITER Tokamak Global Coordinate System

There is one Global Coordinate System for the ITER site. This system is referred to as the “Tokamak Global Coordinate System” (TGCS).

The origin of the TGCS is the nominal centre of the Tokamak machine.

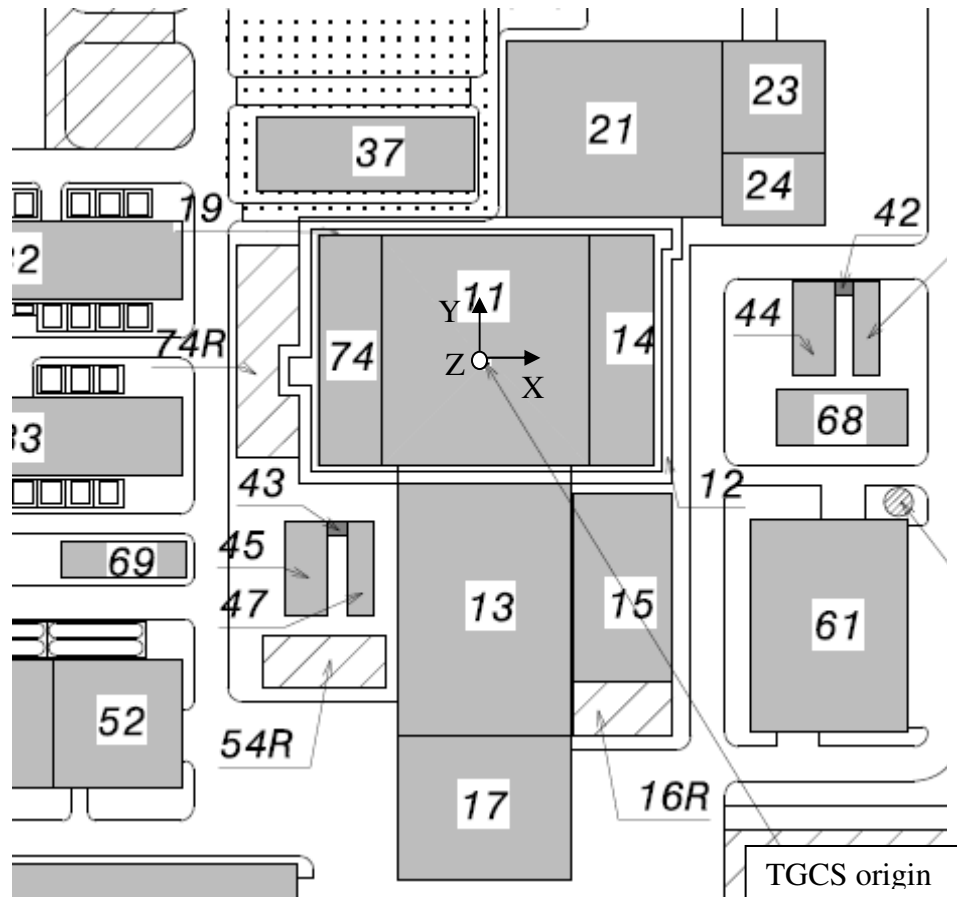


Figure 2 : TGCS origin localization

To illustrate precisely the location of the centre of the Tokamak machine inside the Tokamak building, please refer to the drawings in paragraph 5.

The TGCS origin coordinates can be described with the French Lambert III and NGF-IGN69 systems, as described above and as follows :

ITER TGCS (Tokamak Global Coordinate System) (m)	Lambert III and NGF-IGN69 (m)
X = 0.000	X = 877220.160
Y = 0.000	Y = 162276.390
Z = 0.000	Z = 316.680

Table 1: TGCS origin coordinates in the French System

The TGCS is rotated on the Z axis in counter clockwise direction precisely by 37.0 degrees relative to the Geographic North :

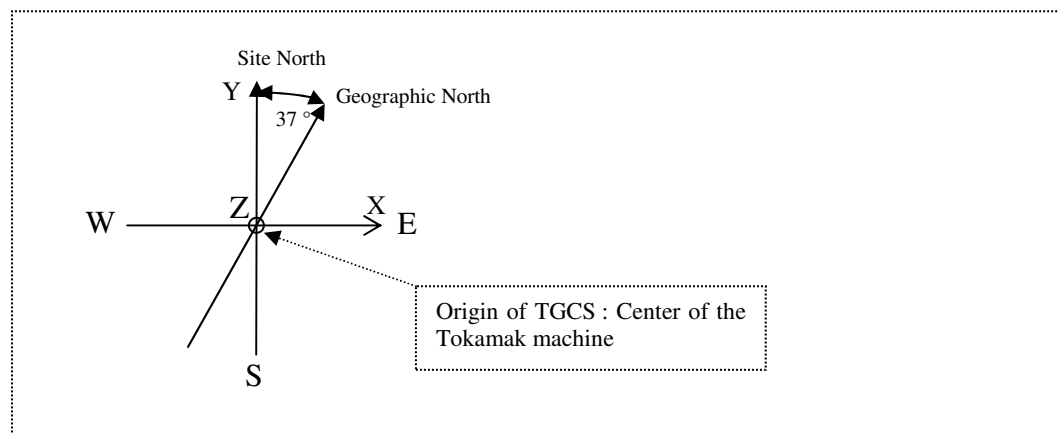


Figure 3 : Rotation of the TGCS with respect to the Geographic North

In the TGCS, the X axis direction indicates the “East” of the site, and the Y axis direction indicates the “North” of the site, called “Site North”.

Transformations between the French coordinate systems and the TGCS must be made or checked by the Design Office.

For information only, the average elevation of the general site platform will be approximately 315 m according to the NGF-IGN69 system i.e. approximately 1.68 metres below the elevation of the TGCS origin.

3 ITER Local Coordinate Systems

For each building and area on the ITER site, a local coordinate system will be defined in order to give a reference within one building or area. The origin of a Local Coordinate System is referred to as a **Setting Out Point (SOP)**. Each SOP will be numbered in accordance with the building or area to which they refer (e.g. the SOP for building 61 will be termed SOP61).

3.1 Tokamak Complex Coordinate System

The Tokamak Complex, which consists of the Tritium, Diagnostics and Tokamak building, has the same local coordinate system as the TGCS, except for the elevation of the SOP (SOP 11), which is the upper face of the floor slab, located -1.48 m in Z-direction below the TGCS as shown in Table 2 and Figure 4.

SOP 11 (m)	TGCS (m)	Lambert III and NGF-IGN69 (m)
X = 0.000	X = 0.000	X = 877220.160
Y = 0.000	Y = 0.000	Y = 162276.390
Z = 0.000 (“EL 0”)	Z = -1.480	Z = 315.200

Table 2 : SOP11 coordinates in TGCS & the French System

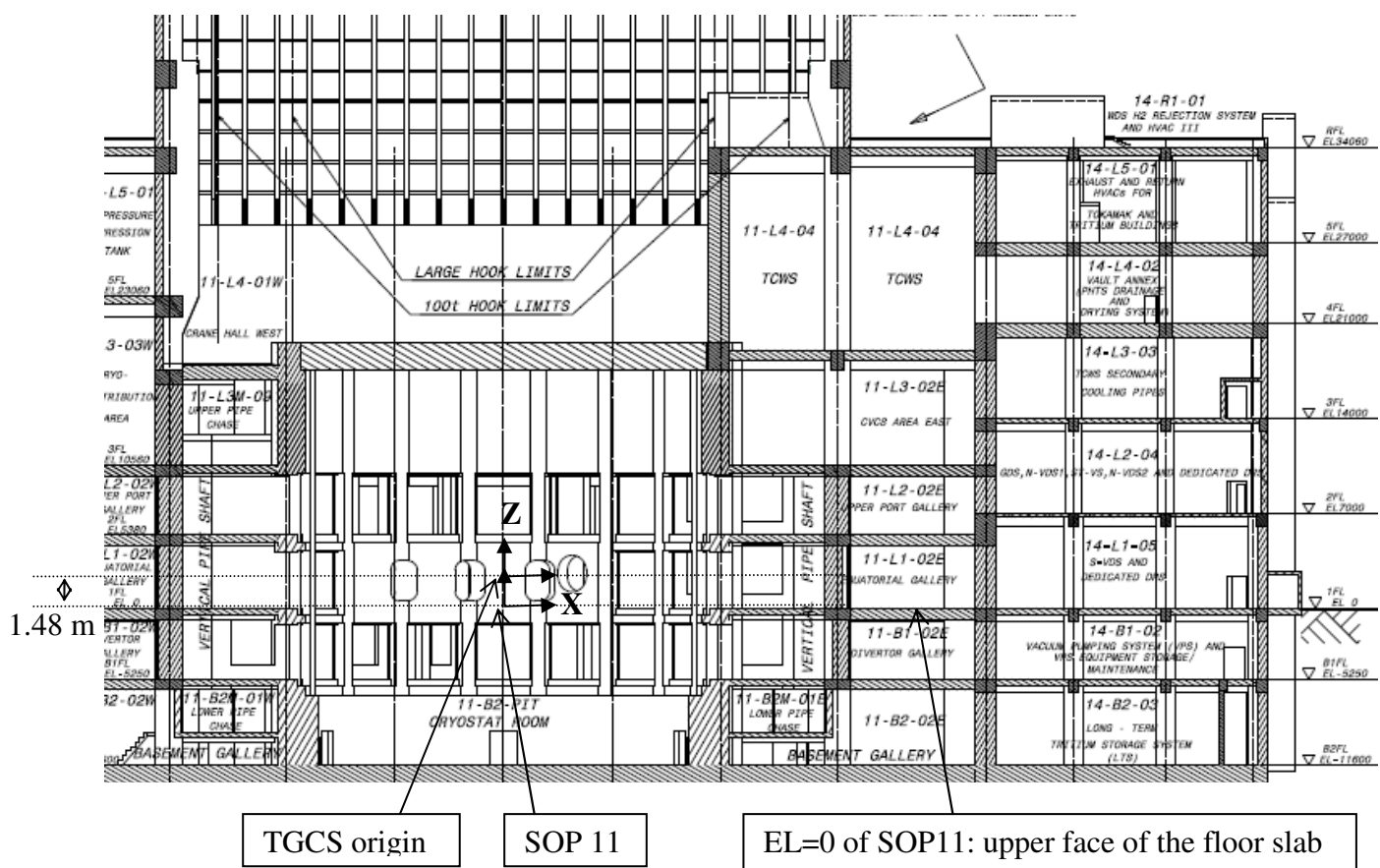


Figure 4 : TGCS and SOP 11 localization (vertical section)

3.2 Definition of Local Coordinate Systems

The origin of the Local Coordinate Systems for each building and area (excluding the Tokamak Complex) is located in the South West corner of the building or area.

Generic examples of the origin of the local coordinate system for concrete and steel buildings are shown in Figures 5 and 6 respectively.

The location and coordinates of each Local Coordinate System will be clearly defined by the Design Office in conjunction with the CCS office using the TGCS system.

They are defined by a translation (in the X, Y and Z Directions) and a plane rotation (measured in degrees, clockwise direction) with respect to the TGCS.

CCS will maintain a site layout skeleton titled “Setting Out Points for Buildings and Areas” showing all SOP’s with their location with respect to the origin of the TGCS and the French Coordinate System, and the rotation that needs to be applied to each Local Coordinate System.

As a general rule for concrete buildings, the SOP will be the external south west corner on the upper face of the floor slab. Note that the upper face of the floor slab is the nominal one, defined during the design, and not the as-built.

As a general rule for steel buildings, the SOP will be the South West intersection point of the centrelines of the structural columns forming the external walls of the building with the upper face of the floor slab.

As a general rule for Areas, the SOP will be South Western limit of the area.

As a general rule, buildings and areas are parallel with the principal axes of the TGCS and therefore in most cases a relative rotation between the TGCS and the applicable Local Coordinate System will not be necessary.

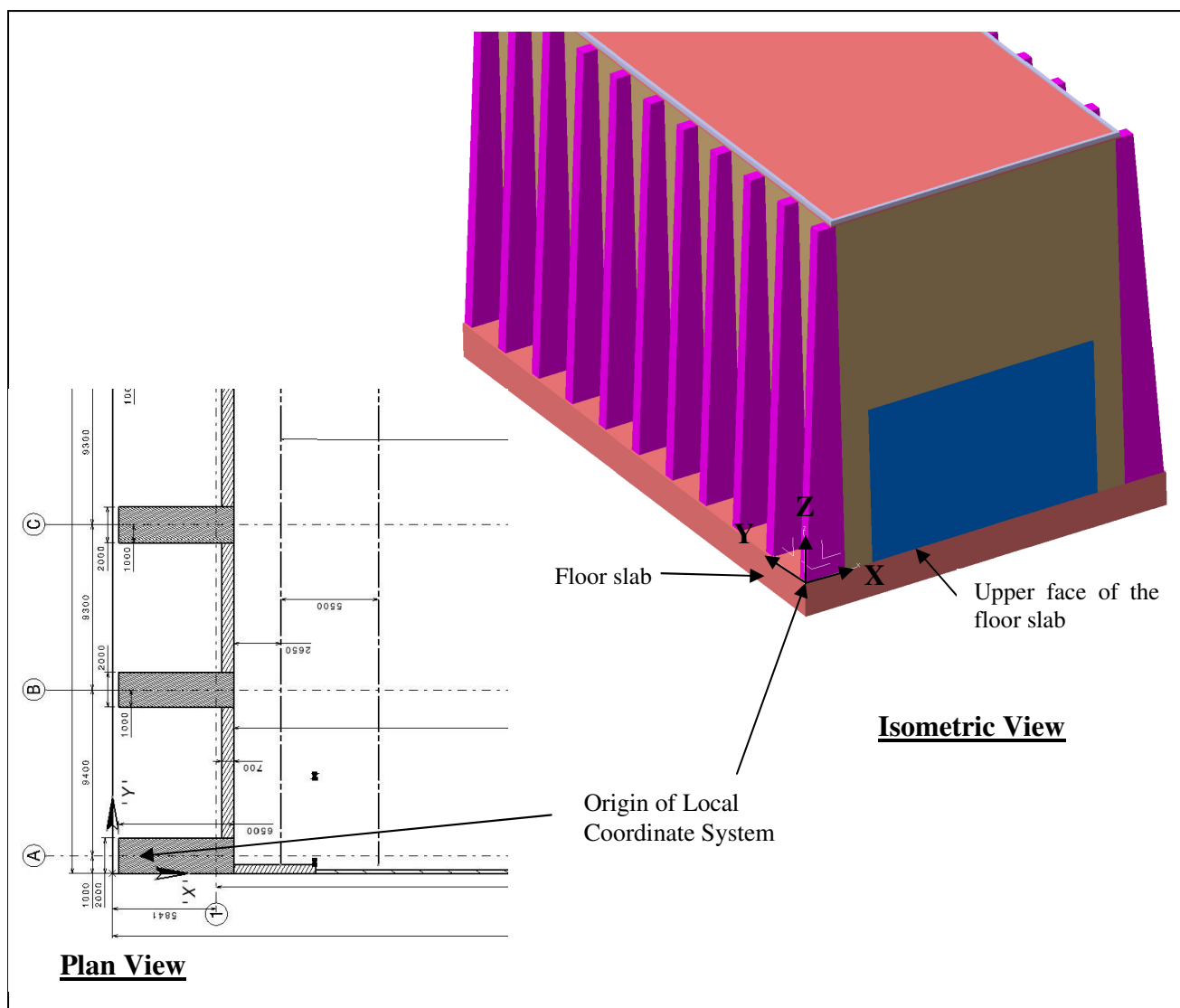


Figure 5 – Typical location of Local Coordinate System origin for a concrete building (except Tokamak Complex)

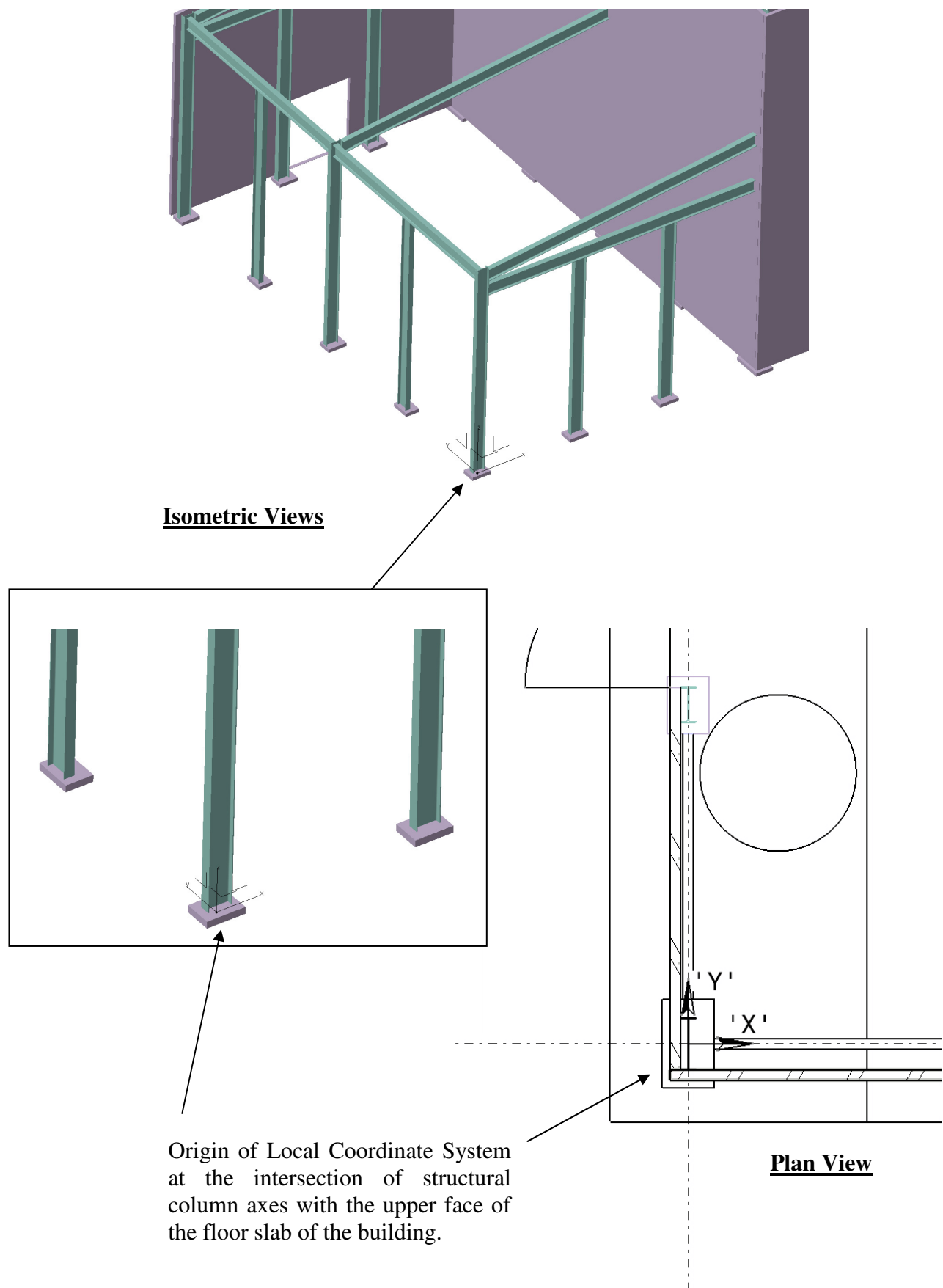


Figure 6 – Typical location of Local Coordinate System origin for a steel framed building

4 Use of Coordinate Systems

The TGCS must be used for :

1. definition of locations which are not within a single defined building or area.
2. definition of the SOP's of buildings and areas
3. positioning of all components in the Tokamak Complex

The Tokamak Complex Coordinate System (using SOP11) must be used for :

1. Civil engineering drawings. Note that the only difference with the use of TGCS is the Z elevation which will refer to the upper face of the floor slab.

The other Local Coordinate Systems with the associated SOP's must be used when defining locations that are within a single defined building or area.

Note that all definition of coordinates must refer to a coordinate system.

As an example :

(X= 3.2 m ; Y= 10.5 m ; Z = 1.7 m) [TGCS] refer to the coordinates using TGCS.

(X= 10.24 m ; Y= 3.2 m ; Z = 4.5 m) [SOP 51] refer to the coordinates using the Local Coordinate System with SOP 51 as origin.

Defined buildings and areas will be given in the CCS drawing titled "Setting Out Points for buildings and areas".

5 ITER center of the Tokamak machine

As shown on the following drawings, the centre of the Tokamak machine is located on a horizontal plane which stands 29 mm below the magnet middle plane at room temperature, and at the intersection between :

- the axis of the Toroidal Field (TF) Coil 01
- the axis of the Vacuum Vessel (VV) Port 5.

Note that the following drawings should be considered only for illustrating the position of the centre of the Tokamak.

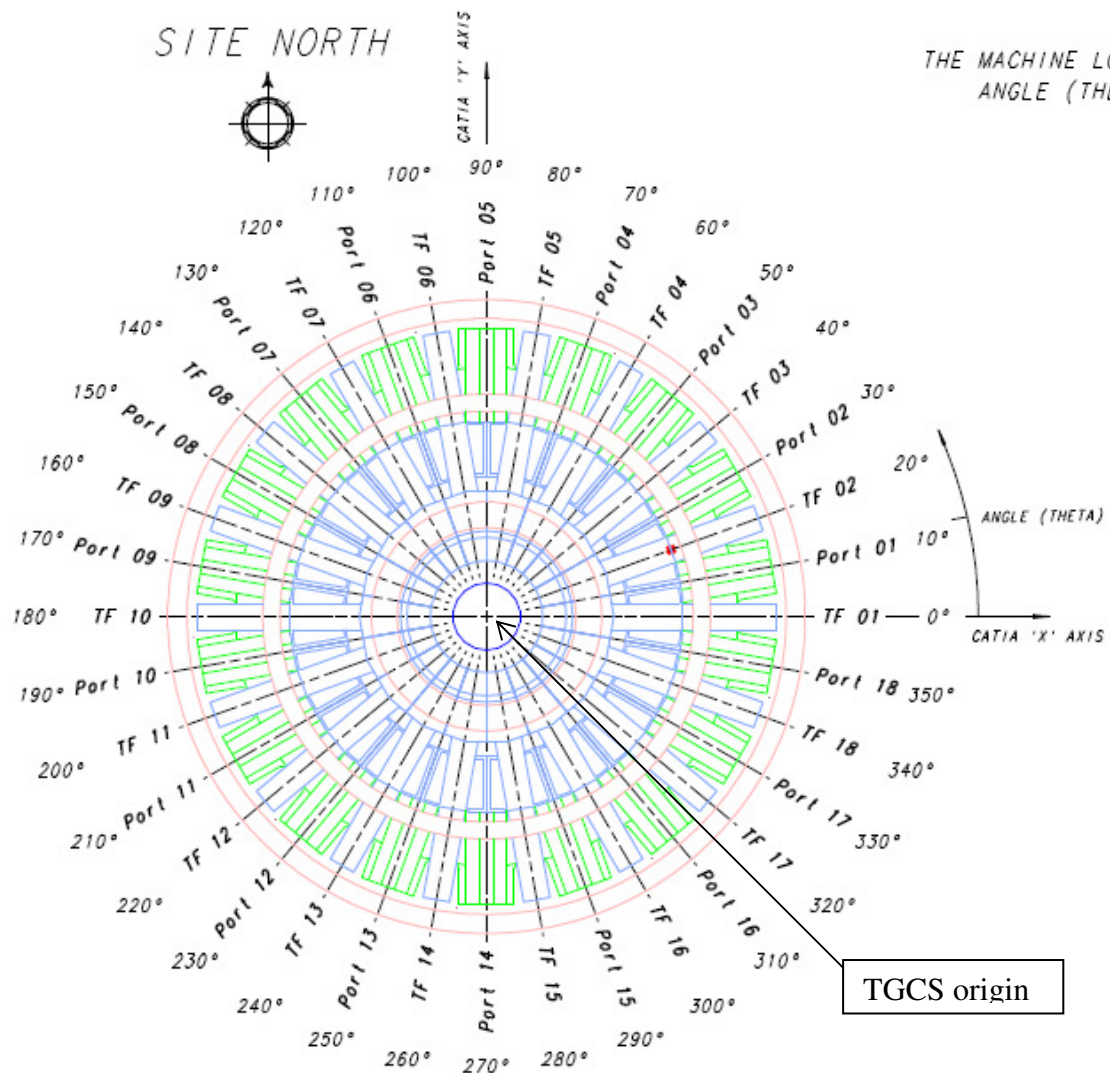


Figure 7 – location of the origin of the TGCS (Plan view)

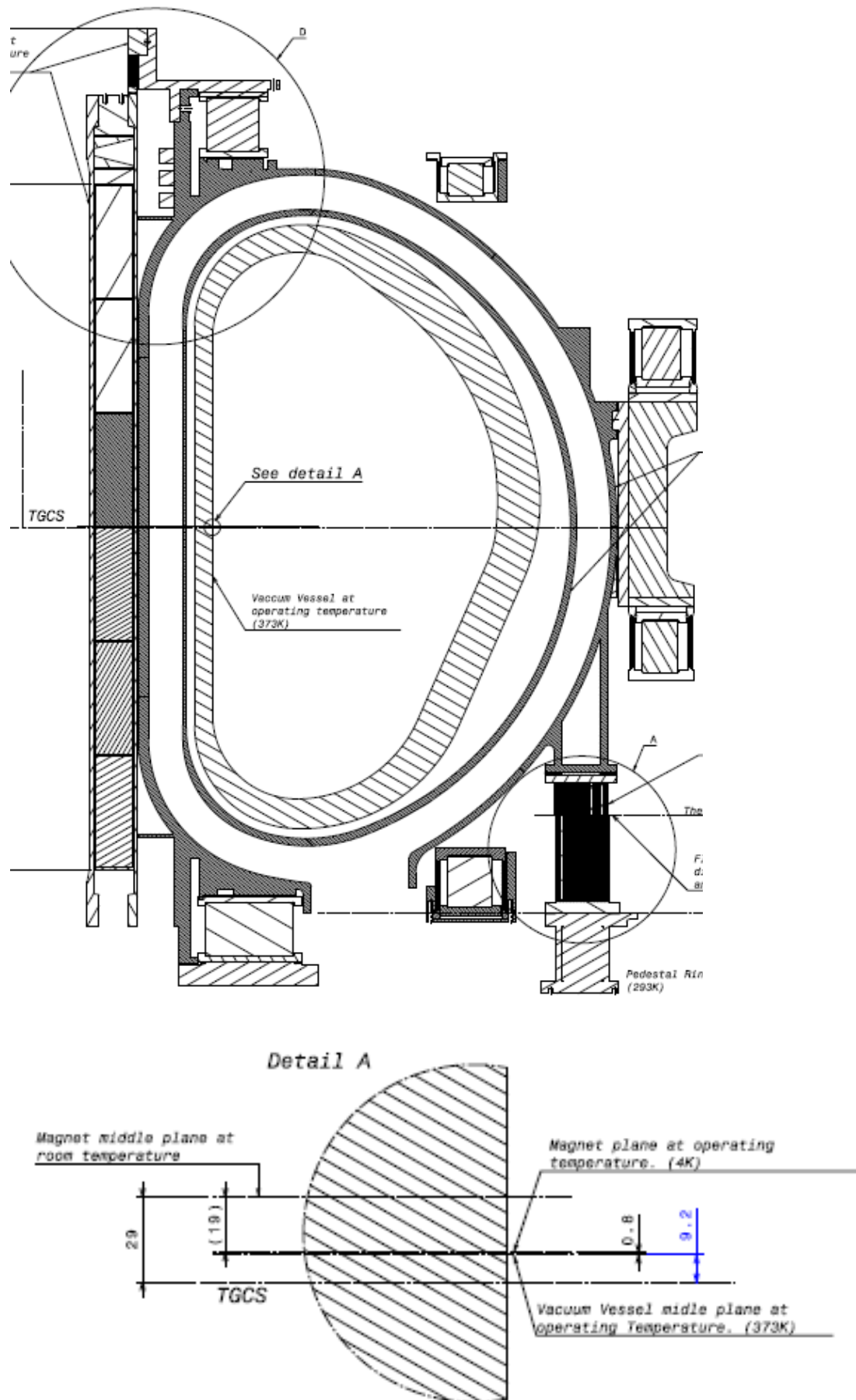


Figure 8 – TGCS plane localization (vertical Section)