

GEOMATICS ENGINEERING DEPARTMENT

SECOND YEAR GEOMATICS

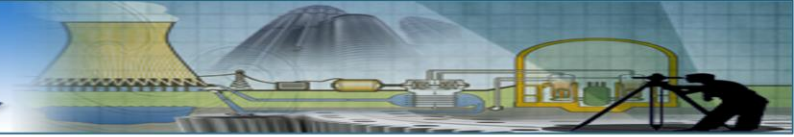
GEODESY 2 (GED209)

LECTURE NO: 4

DATUMS AND GEOID

Dr. Eng. Reda FEKRY

Assistant Professor of Geomatics
reda.abdelkawy@feng.bu.edu.eg



OVERVIEW OF PREVIOUS LECTURE



WHAT IS A COORDINATE SYSTEM?

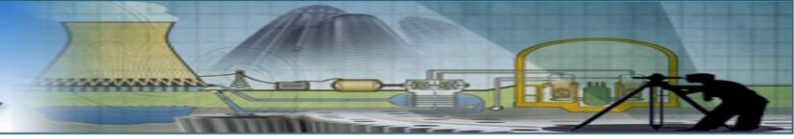
WHERE WE MADE OUR OBSERVATIONS?

COORDINATE SYSTEMS IN GEODESY

RELATION BETWEEN DIFFERENT SYSTEMS

SUMMARY

TAKE HOME ASSIGNMENT



OVERVIEW OF TODAY'S LECTURE



DATUMS

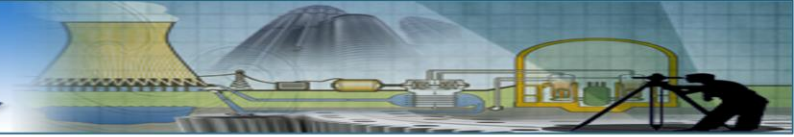
TYPES OF DATUMS

HORIZONTAL DATUMS

VERTICAL DATUMS

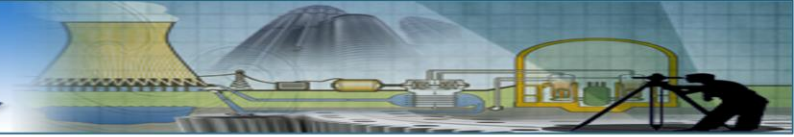
GEOID AND ITS SIGNIFICANCE

SUMMARY



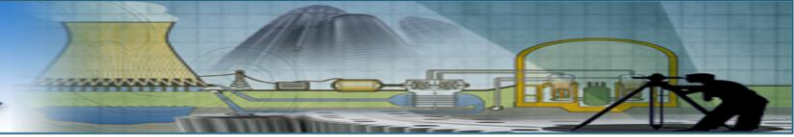
EXPECTED LEARNING OUTCOMES

- Understanding the Concept of Datums.
- Knowledge of Different Types of Datums.
- Learn about horizontal datums, which define the position and coordinates of points on the Earth's surface relative to a reference ellipsoid.
- Gain knowledge about vertical datums, which establish a reference for measuring elevations and heights above or below mean sea level.
- Learn about the geoid, which represents the shape of the Earth's surface considering the mean sea level.
- Understand the importance of the geoid in various fields.



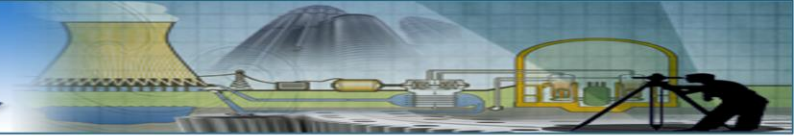
WHAT IS A COORDINATE SYSTEM?



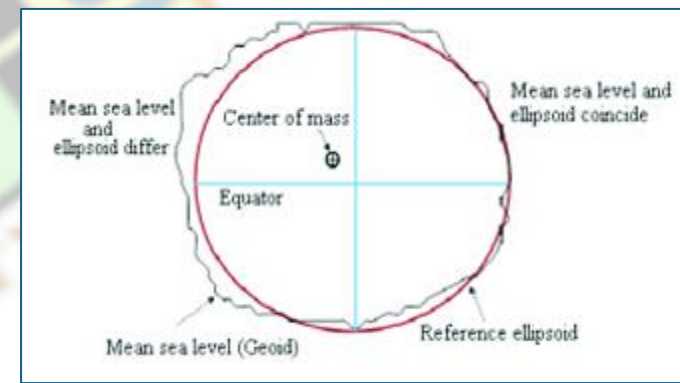
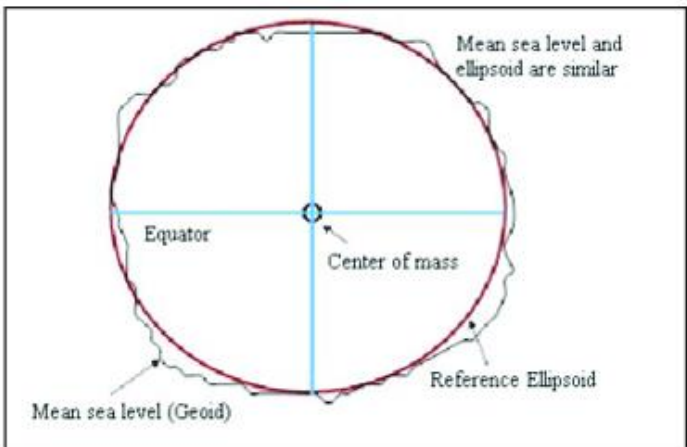
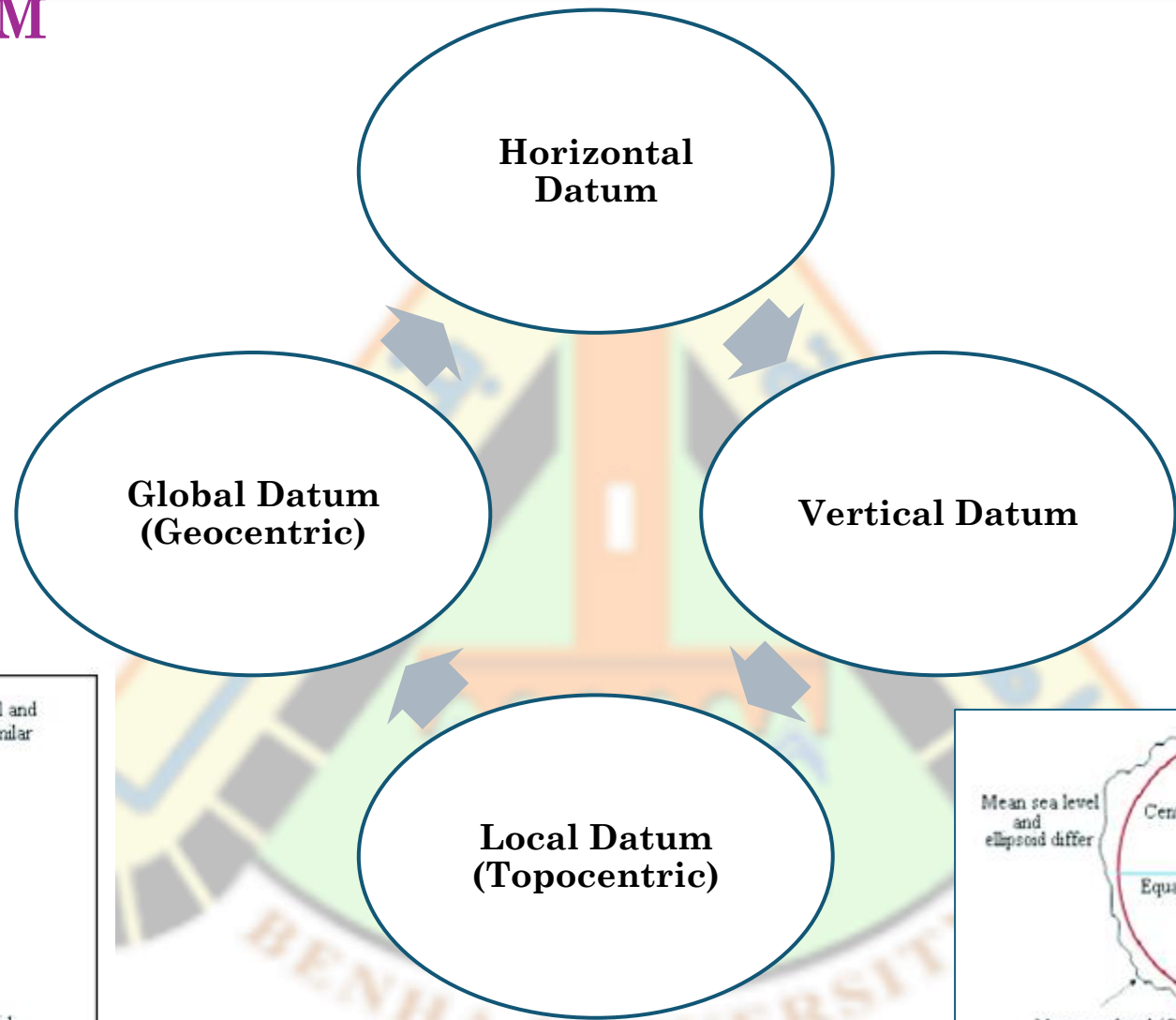


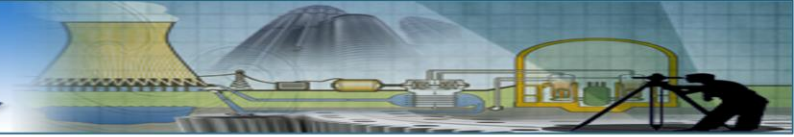
DATUM

- In Geomatics, a datum refers to a reference system or framework used to define the spatial coordinates of points on the Earth's surface.
- It provides a consistent and standardized basis for measurements and mapping.
- The datum serves as a geometric reference for establishing the position, orientation, and scale of surveyed features or objects.
- A datum is built on top of the selected spheroid and can incorporate local variations in elevation. With the spheroid, the rotation of the ellipse creates a totally smooth surface across the world. Because this doesn't reflect reality very well, a local datum can incorporate local variations in elevation.



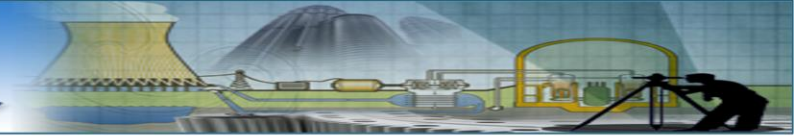
TYPES OF DATUM





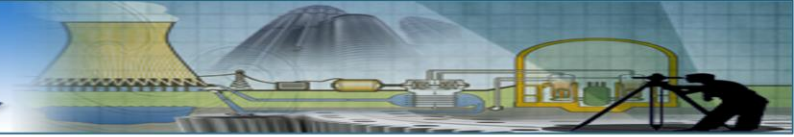
TYPES OF DATUM

- **Horizontal Datum:** This component defines the reference for measuring horizontal positions or coordinates on the Earth's surface. It establishes the latitude and longitude values for a specific point, often referred to as the origin or the zero point. Commonly used horizontal datums include NAD83 (North American Datum 1983) and WGS84 (World Geodetic System 1984).
- **Vertical Datum:** The vertical datum establishes the reference for measuring elevations or heights above or below a specified surface, such as mean sea level or a specific geoid model. It provides a consistent basis for determining the height or depth of points on the Earth's surface. Examples of vertical datums include NAVD88 (North American Vertical Datum 1988) and EGM2008 (Earth Gravitational Model 2008).

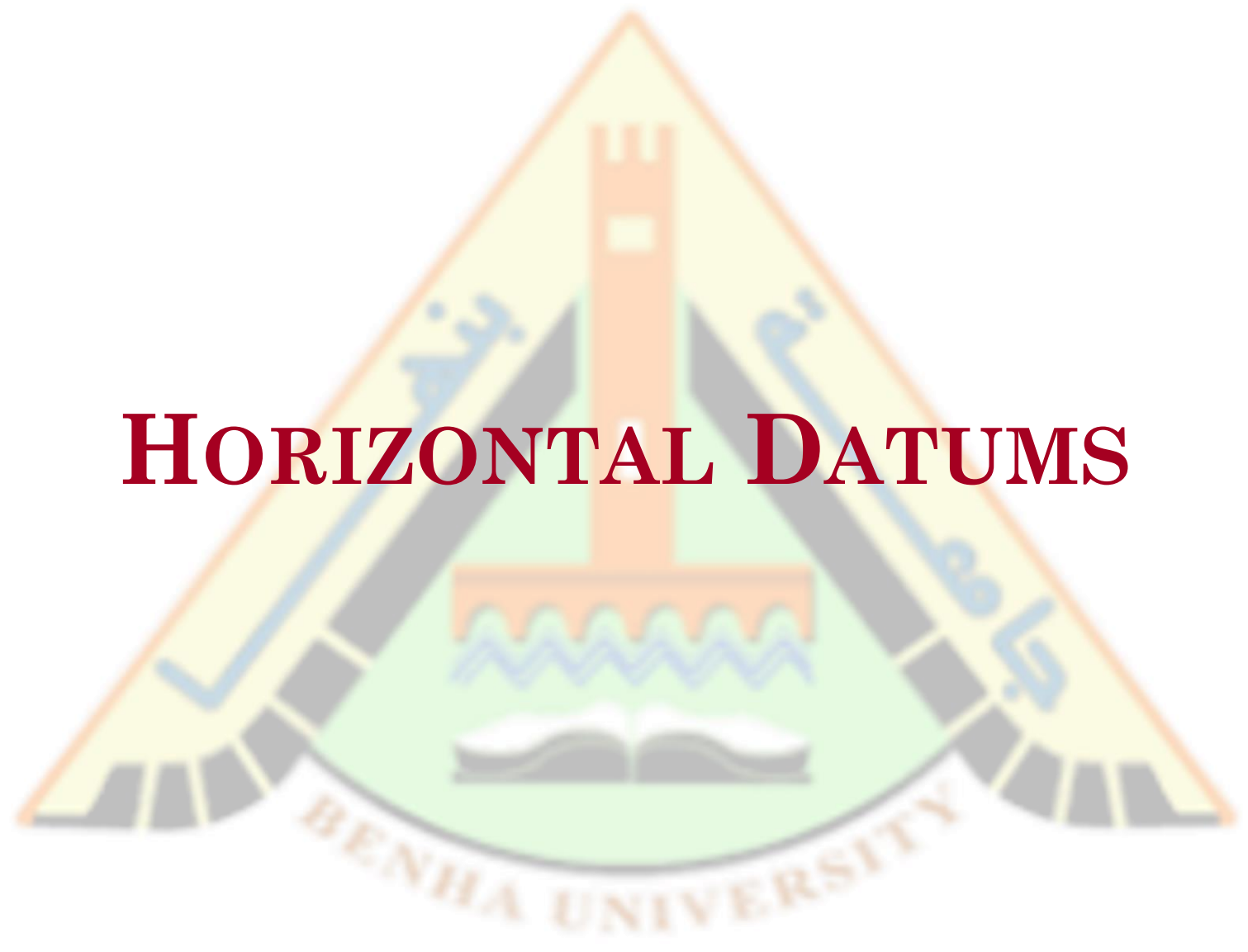


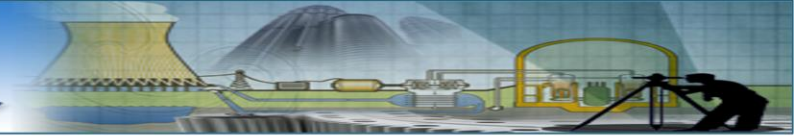
TYPES OF DATUM

- **Global Datum:** refers to a datum that is designed to provide a consistent and standardized reference system for measurements and mapping on a global scale. It serves as a common reference framework for geospatial data and facilitates the integration and compatibility of data from various sources and regions worldwide.
- **Local Datum:** In some cases, a local datum may be used to establish a reference system specific to a particular survey project or area. Local datums are often utilized when the survey work is confined to a small region or when there is a need for a more accurate and tailored reference system for that specific location.



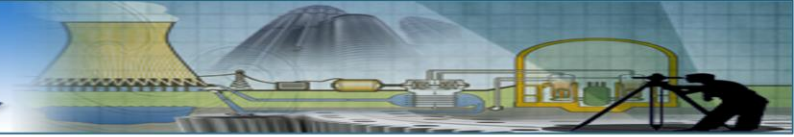
HORIZONTAL DATUMS





REFERENCE ELLIPSOID

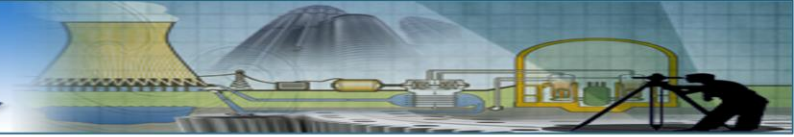
- A mathematical representation of the shape of the Earth's surface. Reference for horizontal positions of the points on the earth's surface.
- A point on ellipsoid is often described using a set of ellipsoidal coordinates, such as latitude (φ), longitude (λ), and ellipsoidal height (h). These coordinates are used in geodesy and surveying to represent and calculate positions on the Earth's surface.
- Different reference ellipsoids have been established over time to represent the Earth's shape accurately. **WHY?**



REFERENCE ELLIPSOID

Examples of widely used reference ellipsoids include:

- International Ellipsoid 1924 (Hayford Ellipsoid): It was widely used in the 20th century and formed the basis for the North American Datum (NAD27).
- World Geodetic System 1984 (WGS84): This reference ellipsoid is commonly used in global navigation systems, such as GPS, and forms the basis for the WGS84 datum.
- Geodetic Reference System 1980 (GRS80): GRS80 is used in many modern geodetic systems and serves as the reference ellipsoid for the North American Datum 1983 (NAD83).

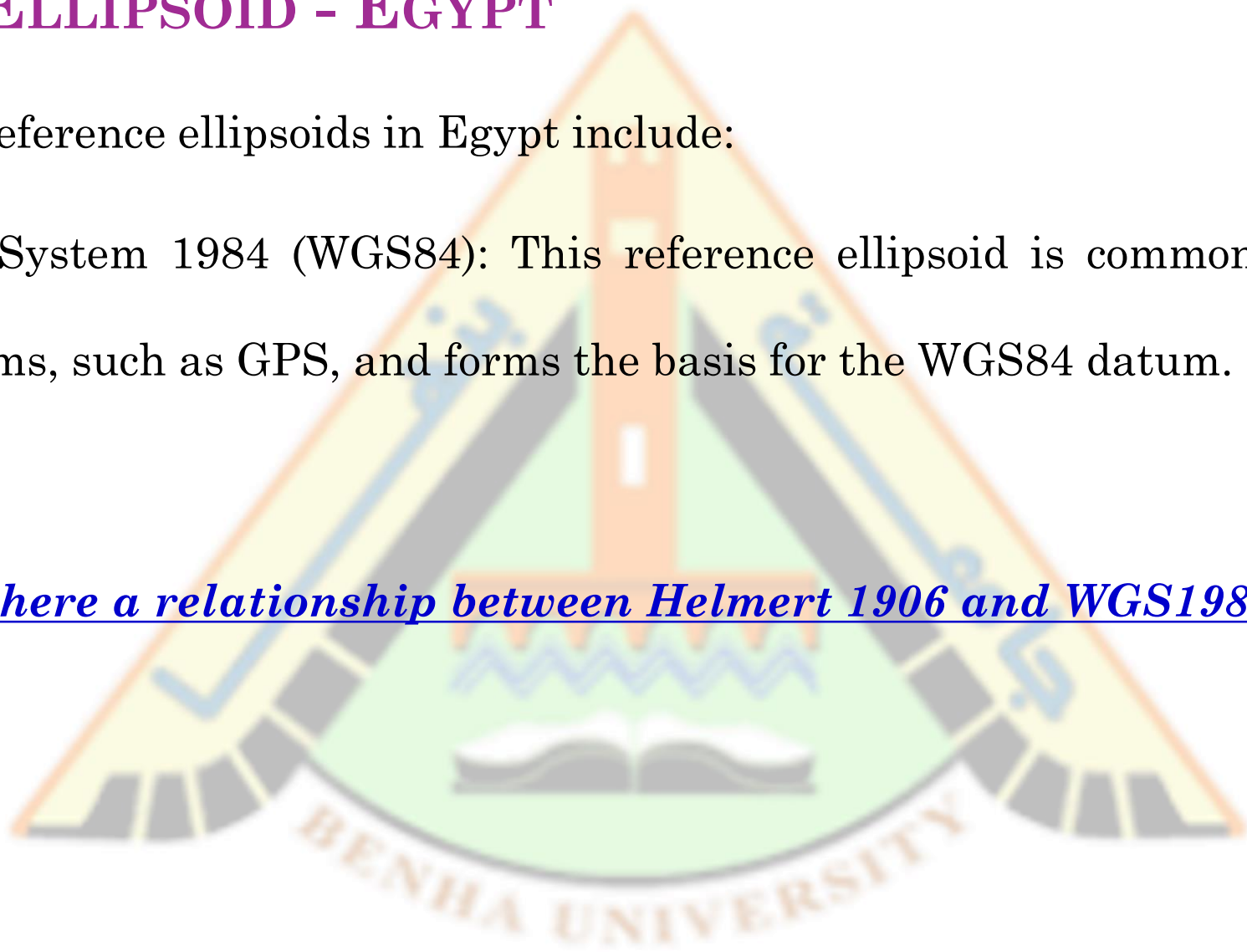


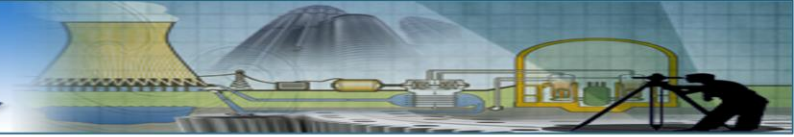
REFERENCE ELLIPSOID - EGYPT

Examples of used reference ellipsoids in Egypt include:

- World Geodetic System 1984 (WGS84): This reference ellipsoid is commonly used in global navigation systems, such as GPS, and forms the basis for the WGS84 datum.
- Helmert 1906.

Is there a relationship between Helmert 1906 and WGS1984?

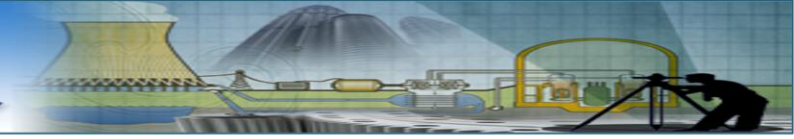




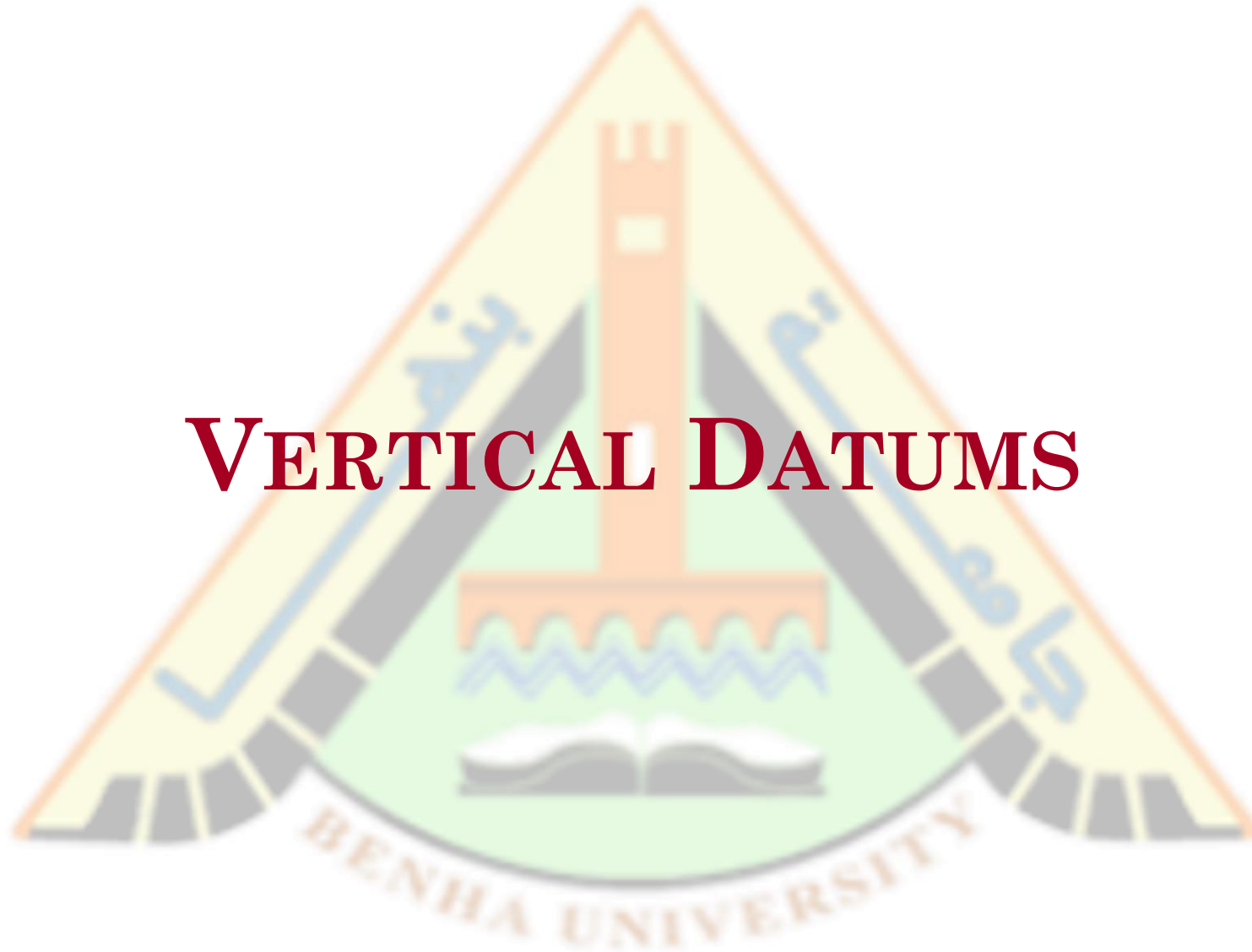
DATUM TRANSFORMATIONS

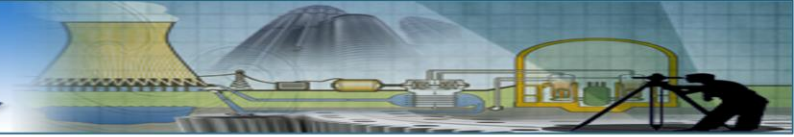
What does this mean?





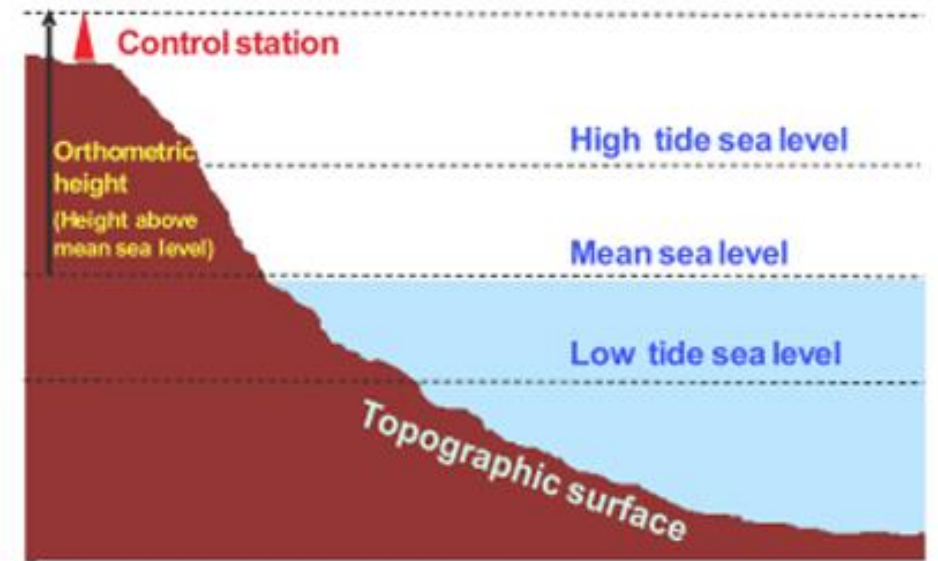
VERTICAL DATUMS

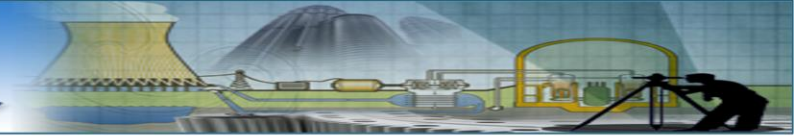




GEOID

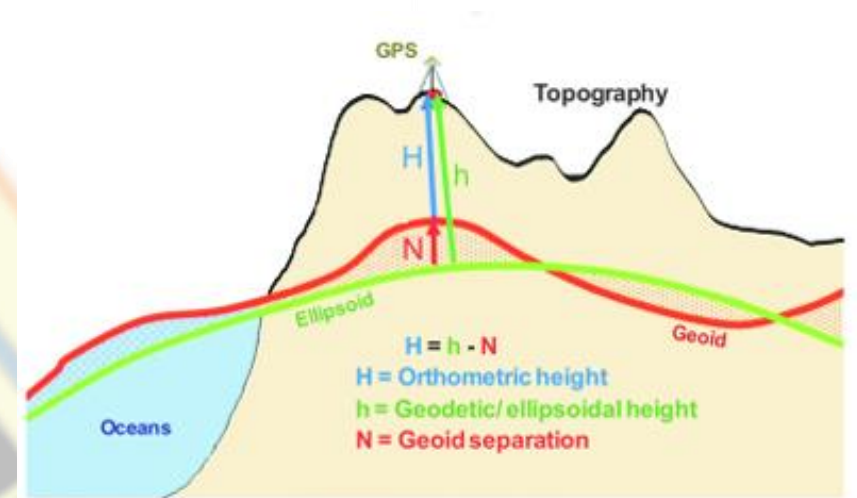
- The geoid is defined as the surface of the earth's gravity field, which is approximately the same as mean sea level.
- It is perpendicular to the direction of gravity pull. Since the mass of the earth is not uniform at all points, and the direction of gravity changes, the shape of the geoid is irregular.
- The geoid is irregular and undulating, reflecting the true shape of the Earth's surface.
- It deviates from a perfect ellipsoid due to the non-uniform distribution of Earth's mass, including variations in the density of rocks and the presence of mountains, ocean trenches, and other geological features.

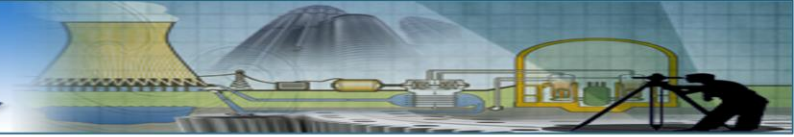




SIGNIFICANCE OF GEOID

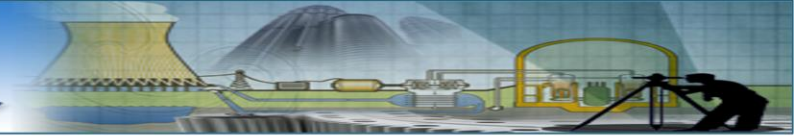
1. The geoid provides a reference surface for measuring elevations and heights above or below mean sea level.
2. The geoid plays a crucial role in precise positioning systems like GPS (Global Positioning System).
3. The geoid is intimately connected to Earth's gravity field. Variations in the geoid reflect the uneven distribution of Earth's mass. By studying the anomalies in the geoid, scientists can gain insights into the Earth's internal structure, such as the density variations in the lithosphere and mantle, and understand processes like tectonic plate movements, isostatic adjustments, and mass redistributions due to ice melting or deposition.





SIGNIFICANCE OF GEOID

4. The geoid plays a crucial role in understanding and monitoring sea level changes. By combining satellite altimetry measurements with precise geoid models, scientists can determine changes in sea level relative to the geoid surface.
5. Geodetic control networks are networks of precisely measured points that serve as reference points for surveys and mapping. The geoid provides the vertical reference for establishing accurate heights within these networks.
6. The geoid is used in the definition and realization of geodetic datums, such as vertical datums.



END OF PRESENTATION

THANK YOU FOR ATTENTION!

