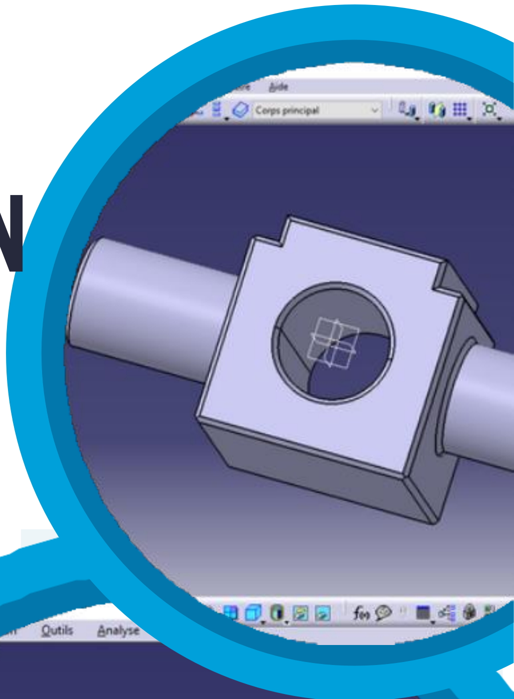
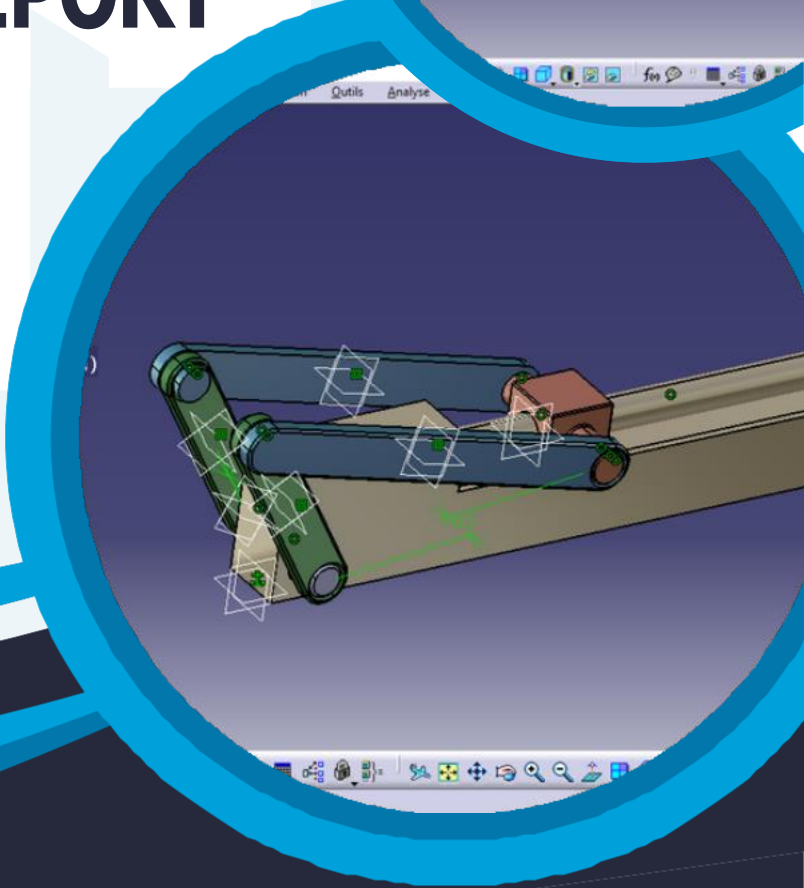
3D MODELING AND KINEMATIC SIMULATION OF A SLIDER-CRANK MECHANISM REPORT





Prepared By:

RAFIK YASSINE

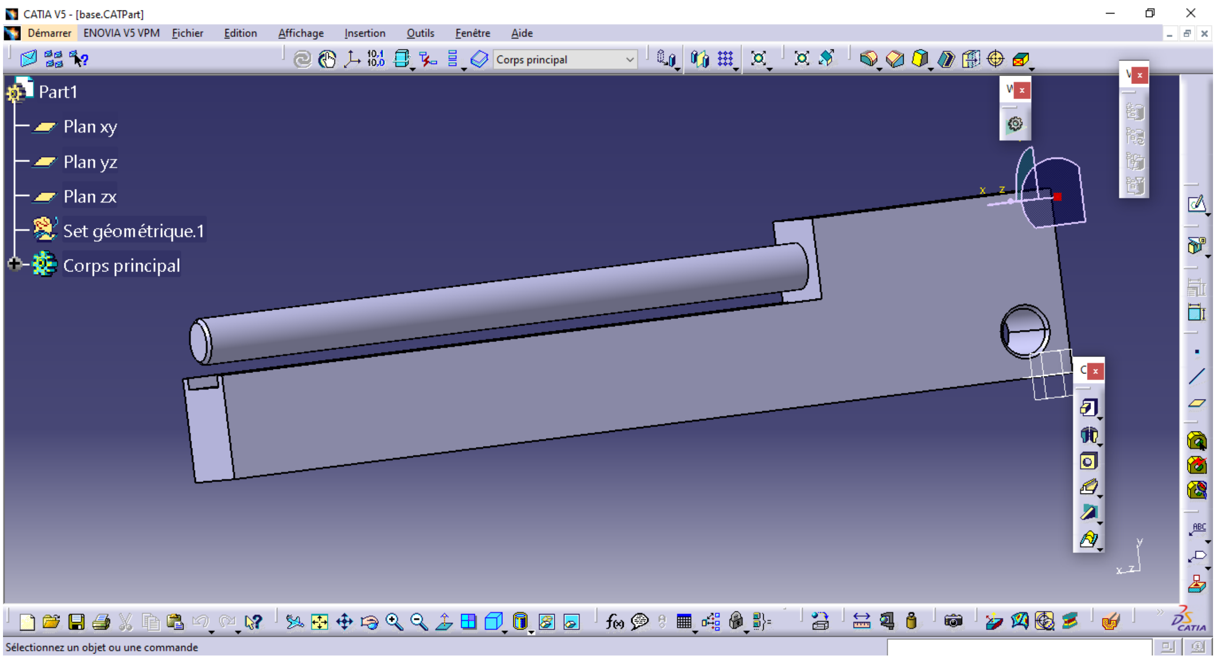
1. Introduction

This report details the design and kinematic simulation of a mechanical linkage, specifically a variation of a slider-crank mechanism. The project was executed using **CATIA V5**, utilizing the Part Design, Assembly Design, and DMU Kinematics workbenches. The primary objective was to model the individual components accurately, assemble them with the correct spatial constraints, and simulate the conversion of rotary motion into reciprocating linear motion.

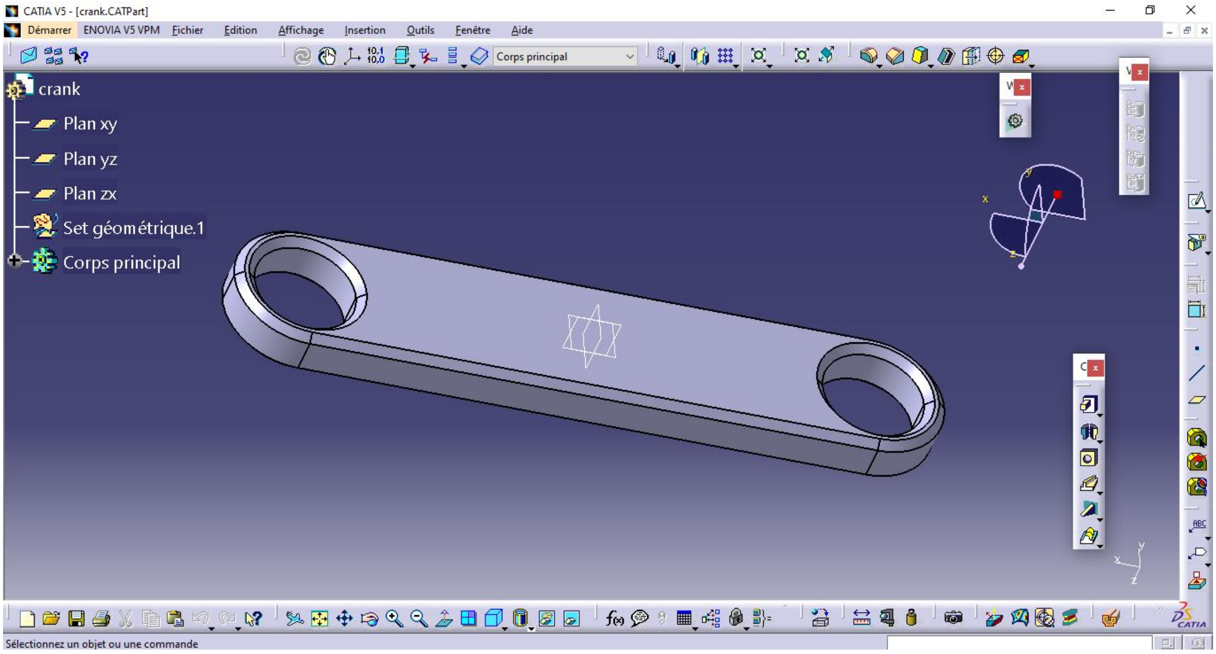
2. Component Design (Part Design Workbench)

The mechanism consists of four distinct structural parts, modeled independently:

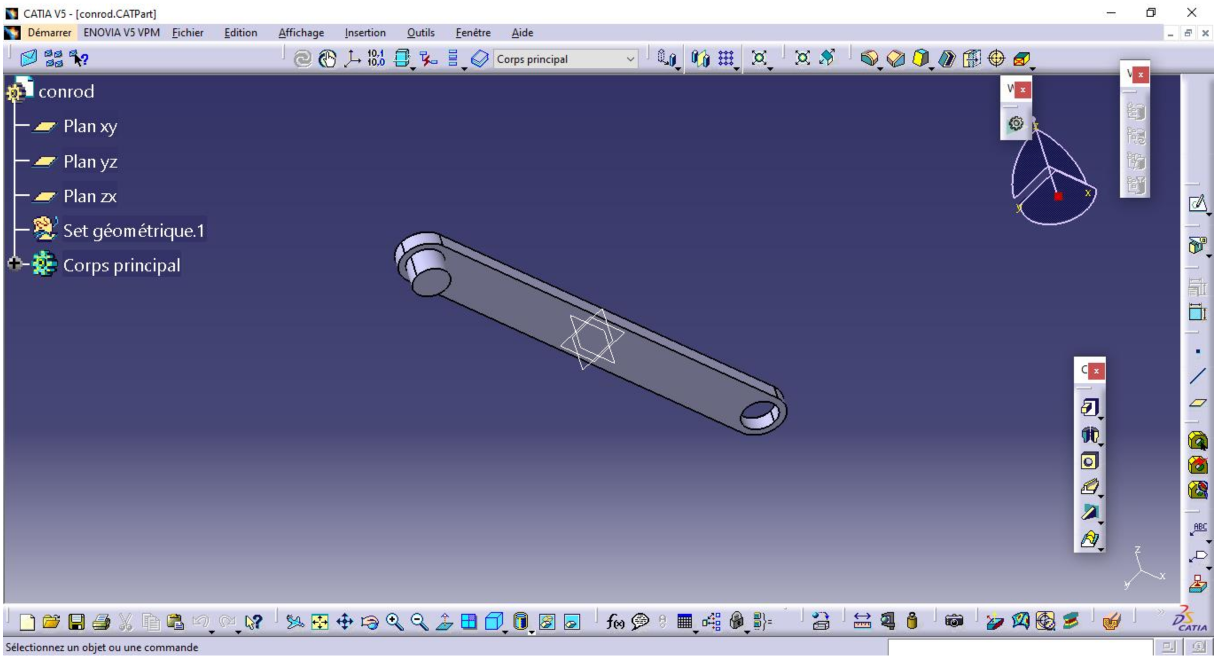
- **Base:** Acts as the fixed ground link for the mechanism. It features a cylindrical pivot pin for the crank and a long slotted guide rail to dictate the linear path of the slider.



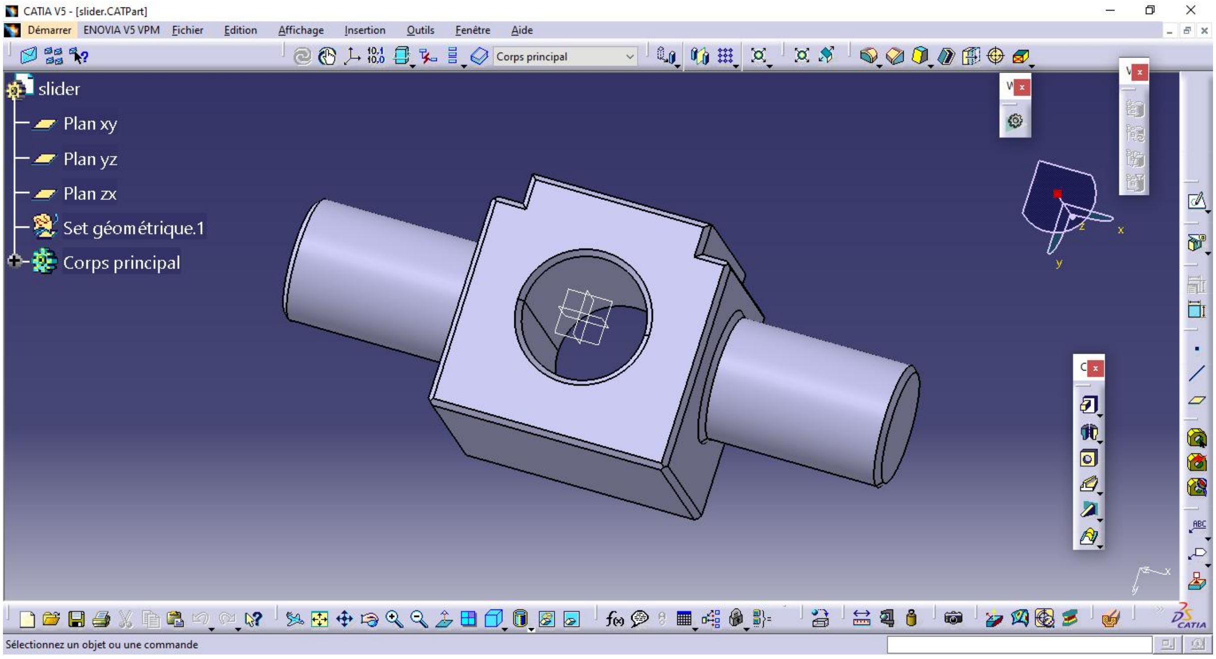
- **Crank:** The input link of the mechanism. It is a dual-holed linkage arm that rotates around the base's fixed pivot, driving the rest of the system.



- **Connecting Rod:** Two identical connecting rods were modeled. These act as the intermediate coupler links that transmit the motion from the rotating crank to the translating slider.



- **Slider :** The output link. It features lateral cylindrical pins to connect to the connecting rods and a central geometric profile designed to slide smoothly within the guide rail of the base.



3. Assembly Design

The individual parts were brought into the Assembly Design workbench to form the complete mechanism. Structural integrity and proper alignment were achieved using standard assembly constraints:

- **Coincidence constraints** to align the rotational axes of the pins and holes (e.g., base pin to crank hole, crank pin to conrod holes).
- **Contact/Offset constraints** to ensure the faces of the linkages rest properly against one another without geometric interference.

4. Kinematic Simulation (DMU Kinematics)

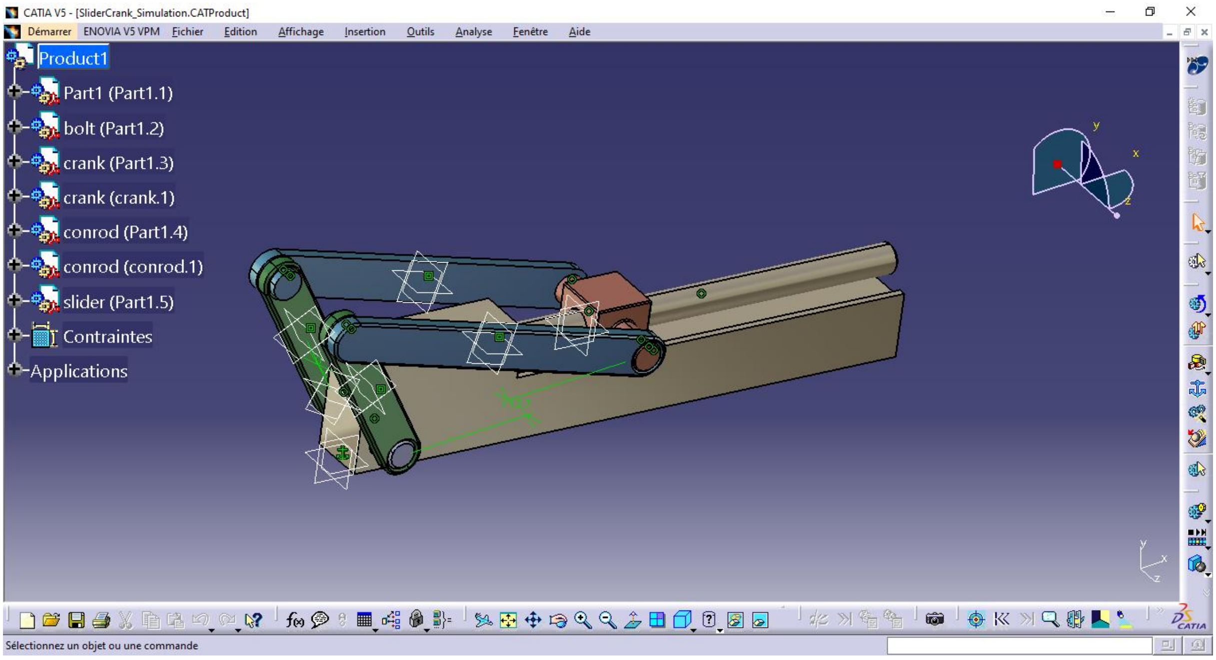
To verify the mechanical behavior of the assembly, a simulation was set up in the DMU Kinematics module.

Mechanism Setup:

- Fixed Part: The base was anchored as the fixed frame of reference.
- Joint Definitions: * Revolute Joints were created at the pivot points (Base/Crank, Crank/Conrods, and Conrods/Slider) to allow rotational freedom.
  - A Cylindrical/Prismatic Joint was established between the Slider and the Base to restrict the slider's movement to a single linear translation axis.

Simulation Execution:

- An angular command was applied to the initial revolute joint (between the base and the crank) to act as the driving motor.
- The command parameters were set to drive the crank through a full 360-degree rotation.
- **Result**: The simulation successfully played out the kinematics. As the crank rotated continuously, the connecting rods pulled and pushed the slider block, forcing it to undergo smooth, reciprocating linear translation along the fixed base rail, confirming the mechanism works as intended without kinematic locking.



5. Conclusion

The project successfully demonstrates the end-to-end process of designing a functional slider-crank mechanism. The use of CATIA V5 allowed for precise solid modeling of the components, accurate assembly constraints, and a successful digital mockup (DMU) simulation that validated the kinematic viability of the mechanical design.