

# Heavy-Lift Hydraulic Pushing & Alignment System

A strategic technical solution for the construction industry

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## 1. ABSTRACT.

This article presents the development and implementation of a **hydraulic pushing and alignment system** designed to reposition a large reinforced concrete wall within a civil construction project.

The structure consisted of an **L-shaped concrete wall**, measuring **34 meters in length** and **3.6 meters in height**, with an estimated load capacity of **140.25 tons**.

The engineering challenge involved designing a system capable of **applying controlled horizontal force**, ensuring **gradual movement, structural stability, and precise alignment**, while preventing excessive stress on the structure and its support points.

To achieve this objective, a **hydraulic pushing system based on synchronized hydraulic cylinders** was developed, enabling the safe and progressive repositioning of the structure

## 2. INTRODUCTION.

In civil construction and structural engineering projects, situations often arise where installed structures require repositioning or structural alignment.

Conventional methods, such as the direct use of cranes or manual mechanical force, may present limitations related to:

- Displacement control,
- Load distribution,
- Operational safety,
- Alignment accuracy,

Hydraulic systems provide an efficient solution due to their capability to generate **high forces with precise motion control**.



Figure: Testing and installation of large structure elements

In this project, a **hydraulic pushing system for heavy loads** was developed, specifically designed to move and align a reinforced concrete structural wall.

## 3. STRUCTURAL CHARACTERISTICS.

The structure targeted for repositioning presented the following main characteristics:

PARAMETER	VALUE
Structure type	Reinforced concrete wall
Geometry	L-shaped configuration
Total length	34 m
Height	3.6 m
Estimated weight	140.25Ton
Load type	Rigid structural load

The **L-shaped geometry** required special attention during the pushing operation, as the distribution of forces needed to prevent:

- Structural torsion,
- Angular misalignment,
- Stress concentration at specific points,

## 4. ENGINEERING CHALLENGES:

The movement of the structure needed to occur in a **progressive and controlled manner**, preventing sudden or uncontrolled displacement.

### 4.1 Uniform Force Distribution

Applying force at a single point could lead to:

- Cracking of the concrete,
- Loss of structural alignment,

For this reason, the system needed to ensure **uniform distribution of the pushing forces**.

## 5. HYDRAULIC SYSTEM CONCEPT.

The system developed was based on the use of **controlled hydraulic pushing cylinders**, strategically positioned along the structure.

The system consisted of the following main components:

- Hydraulic Cylinders With Capacity From 100 To 150 bar,
- Hydraulic Power Unit (HPU) – 700bar,
- High-pressure hydraulic hoses,
- Flow control valves,
- Steel reaction frames,

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The operating principle is simple but extremely efficient:

**Hydraulic pressure → piston force → Controlled displacement of the Structure**

## 6. PUSHING SYSTEM CONFIGURATION.

To ensure the stability of the structure during movement, the hydraulic cylinders were installed at strategic positions along the base of the wall.

The system allowed:

- Gradual pushing,
- Fine alignment adjustments,
- Control of the displacement speed,



*.Figure: Proper alignment of the wall.*

During the operation, the hydraulic pressure was progressively adjusted to ensure that the movement occurred without generating impacts or structural overloads.

## 7. SAFE OPERATIONS.

Safety was considered a critical factor throughout the entire operation.

The following measures were implemented:

- Gradual control of hydraulic pressure,
- Continuous monitoring of structural displacement  
Safe movement of the load,
- Visual inspection of the structure during movement,
- Delimitation of the operational area,

## 8. PROJECT RESULTS.

The implementation of the hydraulic system enabled the successful and controlled repositioning of the structure, achieving the following measurable results:

- **Total displacement achieved:** approximately 2.25 m
- **Final alignment tolerance:** within  $\pm 5$  cm along the 34 m length
- **Operating hydraulic pressure:** ranged between 160 bar and 180 bar during the operation
- **Total execution time:** approximately 16 hours from initial setup to final alignment

## The system ensured:

- controlled and synchronized movement of the structure;
- uniform distribution of forces along the wall;
- absence of visible cracking or structural damage during and after the operation;

The system demonstrated high efficiency in the movement of heavy structures, confirming the feasibility of applying **hydraulic technology in structural repositioning operations**.

## 9. CONCLUSION.

The project demonstrated that hydraulic pushing systems are a highly effective solution for the controlled movement and alignment of heavy concrete structures.

Beyond the successful execution, several key lessons were identified:

- **Force distribution is critical:** the use of multiple hydraulic cylinders significantly reduces the risk of torsion and localized stress.
- **Gradual pressure application improves control:** incremental loading ensures smoother displacement and better alignment accuracy;
- **Structural monitoring is essential:** continuous observation during movement allows early detection of misalignment or instability,
- **Preparation of reaction structures is fundamental:** inadequate reaction frames can compromise the entire operation.

For future projects, it is recommended to:

- integrate displacement measurement tools (e.g., dial gauges or laser alignment systems);
- record real-time pressure and displacement data for performance analysis.
- perform pre-operation simulations to optimize cylinder positioning.

These improvements can further enhance the safety, precision, and efficiency of hydraulic heavy load positioning systems.

## 10. APPLICABLE STANDARDS AND REFERENCES.

The design, execution, and safety considerations of the hydraulic pushing system were guided by

relevant international standards and engineering best practices, including:

- **ISO 4413** – Hydraulic fluid power – General rules and safety requirements for systems and their components;
- **ISO 12100** – Safety of machinery – General principles for design and risk assessment
- **EN 1494** – Mobile or movable jacks and associated lifting equipment
- **ASME B30** – Standards for lifting and material handling equipment

In addition, general principles of structural engineering and fluid mechanics were applied, particularly regarding load distribution, stability, and controlled force application.

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