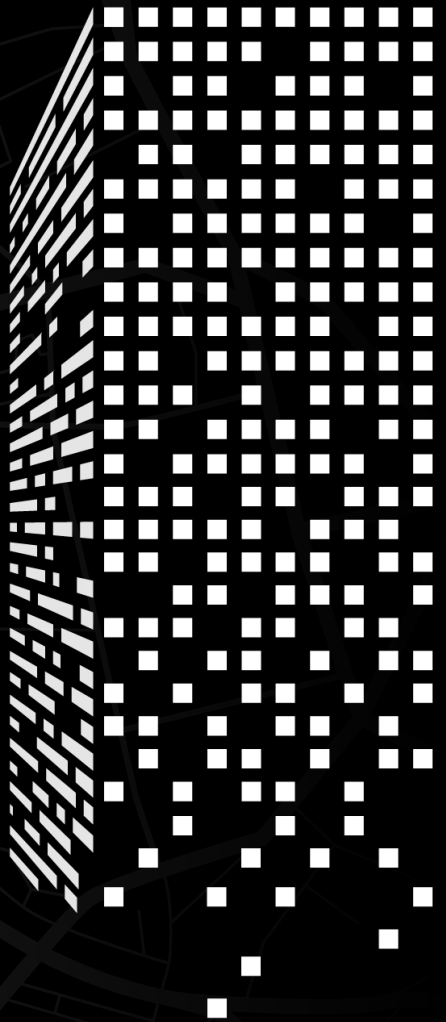
ConstructionMasters

A Database Systems Case Study



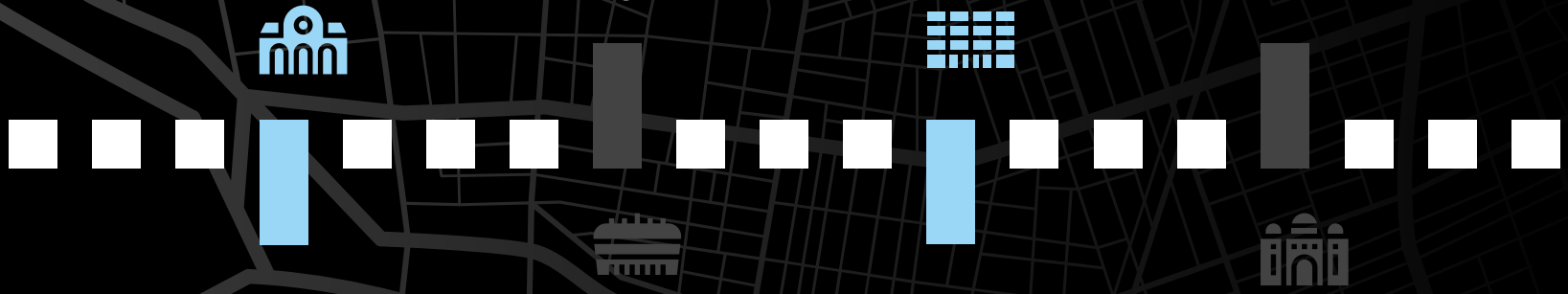
PROJECT OVERVIEW

LOGICAL DESIGN

Table of volumes,
Access tables,
Redundancy Analysis,
Logical Schema

WEB APPLICATION

Servlets and HTML pages developed with Eclipse and Tomcat



CONCEPTUAL DESIGN

Structuring of phrases,
Glossary of terms,
Conceptual schema,
Business rules

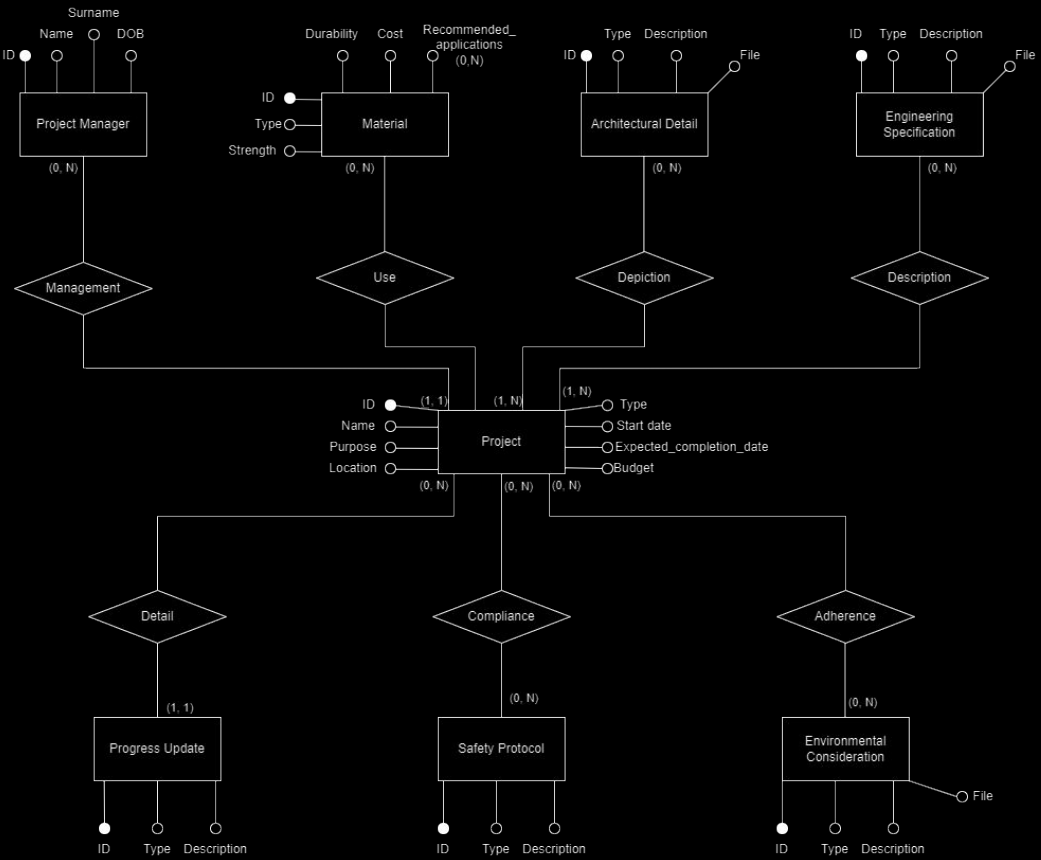
PHYSICAL DESIGN

Types and Tables,
Triggers, Procedures and functions, Query optimization

GLOSSARY OF TERMS

TERM	DESCRIPTION	SYNONYMS	LINKS
Project	Construction endeavor of a specific type (residential, commercial, industrial).	Construction Project	Project Manager, Material, Architectural Detail, Engineering Specification, Progress Update, Safety Protocol
Project Manager	Responsible for overseeing the project.	Manager	Project
Material	Element used in construction (concrete, steel, wood, glass).	Construction elements, Construction materials	Project
Architectural Detail	Architectural designs including building designs, blueprints, floor plans, 3D models.	-	Project
Engineering Specification	Structural designs, load-bearing capacities, safety measures.	-	Project
Progress Update	Milestones achieved and challenges faced in a project.	-	Project
Safety Protocol	Safety measures and regulations for the project.	-	Project
Environmental Consideration	Promotes eco-friendly construction methods.	-	Project

CONCEPTUAL SCHEMA



BUSINESS RULES

01 The ‘Type’ attribute of the ‘Project’ entity must be ‘residential’, ‘commercial’ or ‘industrial’.

02 The ‘Type’ attribute of the ‘Architectural Detail’ entity must be ‘building design, ‘blueprint’, ‘floor plan’, or ‘3D model’.

03 The ‘Type’ attribute of the ‘Engineering Specification’ entity must be ‘structural design, ‘load-bearing capacity’, or ‘safety measure’.

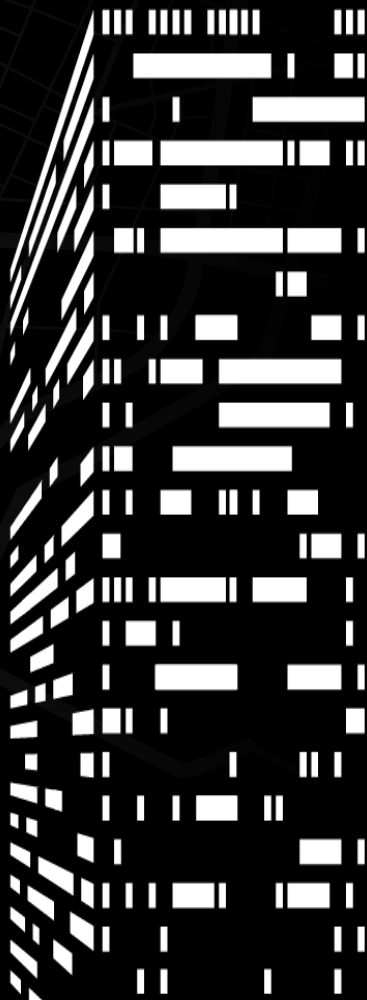
04 The ‘Type’ attribute of the ‘Safety Protocol’ entity must be ‘standard’ or ‘requirement’.

05 The ‘Type’ attribute of the ‘Environmental Consideration’ entity must be ‘construction practice’, ‘design’, or ‘green material’.

06 A new 'Project Manager' can be inserted if their DOB indicates they are 18 years old or older.

07 A project's expected completion date must always be after the start date.

08 The total cost of materials for a project cannot exceed the budget of the project.



LOGICAL DESIGN

TABLE OF VOLUMES

Some volumes were based on specifications, while others were deduced by making some assumptions.

ACCESS TABLES

Estimation of the cost of the described operations on the database.

REDUNDANCY ANALYSIS

A new (redundant) attribute, 'number of milestones', was introduced to reduce the cost of operation 6 from 210˙008 to 10˙008.

OP6 (without redundancy)

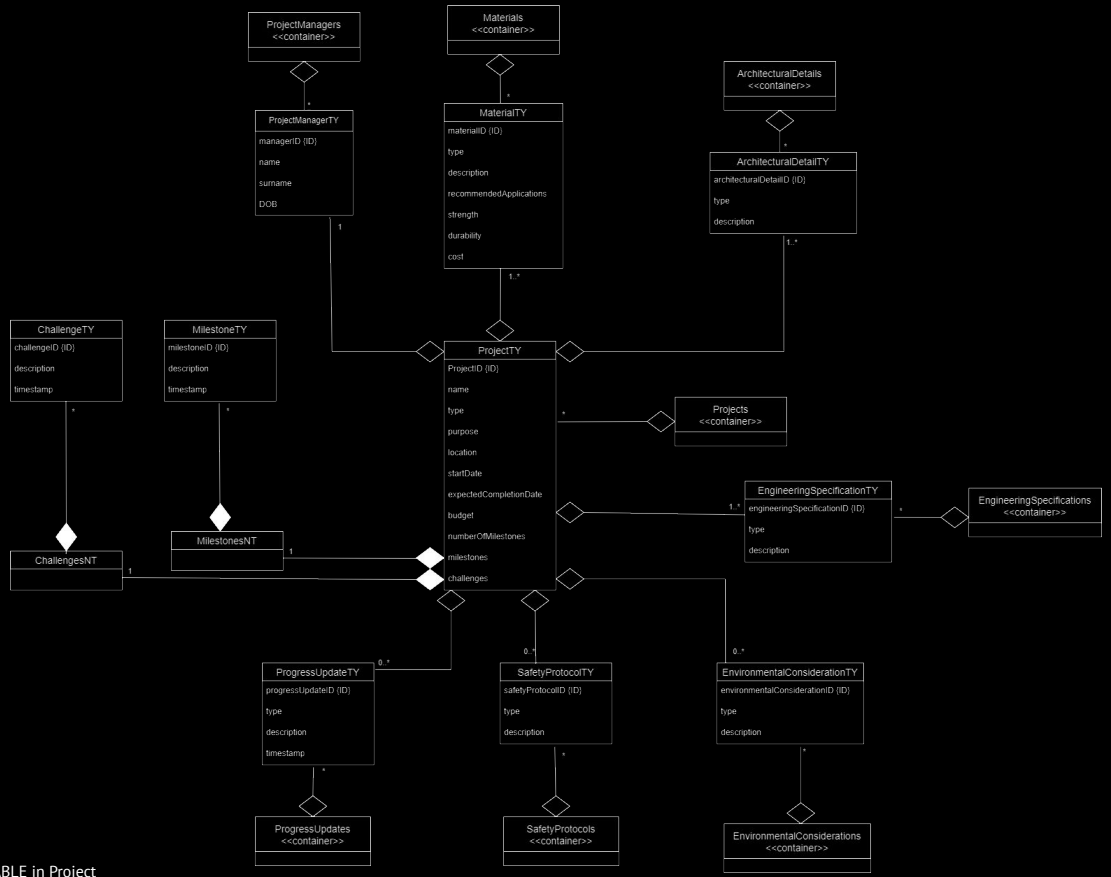
Concept	Type	Accesses	Type	Explanation
Project	E	10000	R	Read all projects
Detail	R	100000	R	Assumption: each project has an average of 10 progress updates
Progress Update	E	100000	R	Assumption: each project has an average of 10 progress updates, need to access all of them to find the milestones
Depiction	R	2	R	Assumption: Each project has 2 architectural details on average
Architectural Detail	E	2	R	Assumption: Each project has 2 architectural details on average
Description	R	2	R	Assumption: Each project has 2 engineering specifications on average
Engineering Specification	E	2	R	Assumption: Each project has 2 engineering specifications on average

OP6 (with redundancy)

Concept	Type	Accesses	Type	Explanation
Project	E	10000	R	Read all projects
Depiction	R	2	R	Assumption: Each project has 2 architectural details on average
Architectural Detail	E	2	R	Assumption: Each project has 2 architectural details on average
Description	R	2	R	Assumption: Each project has 2 engineering specifications on average
Engineering Specification	E	2	R	Assumption: Each project has 2 engineering specifications on average

*omission: 'total material cost' redundant attribute for Operation 5

LOGICAL SCHEMA



*error: ProgressUpdateTY should have have a NESTED TABLE in Project (composition)

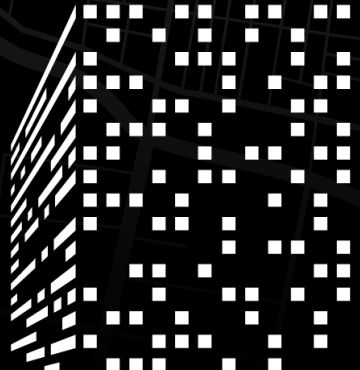
TYPES AND TABLES

TYPES

ProjectManagerType
MaterialType
ArchitecturalDetailType
EngineeringSpecificationType
ProgressUpdateType
SafetyProtocolType
EnvironmentalConsiderationType
MilestoneType
ChallengeType
ProjectType

TABLES

ProjectManager
Material
ArchitecturalDetail
EngineeringSpecification
SafetyProtocol
EnvironmentalConsideration
ProgressUpdate
Project



JUNCTION TABLES

ProjectMaterial
ProjectArchitecturalDetail
ProjectEngineeringSpecification
ProjectSafetyProtocol
ProjectEnvironmentalConsideration
ProjectProgressUpdate

TRIGGERS

ENFORCING TYPES

`project_type_check`
`architectural_detail_type_check`
`safety_protocol_type_check`
`environmental_consideration_type_check`

MANAGER AGE

`ProjectManagerDOBCheck`

PROJECT DURATION

project_date_check
(the expected end date must follow the start date)

BUDGET VS. COST

check_budget
(the cost of the materials used in the project must not exceed the budget)

FUNCTIONS

insert_new_project
Creates a new project with the specified attributes

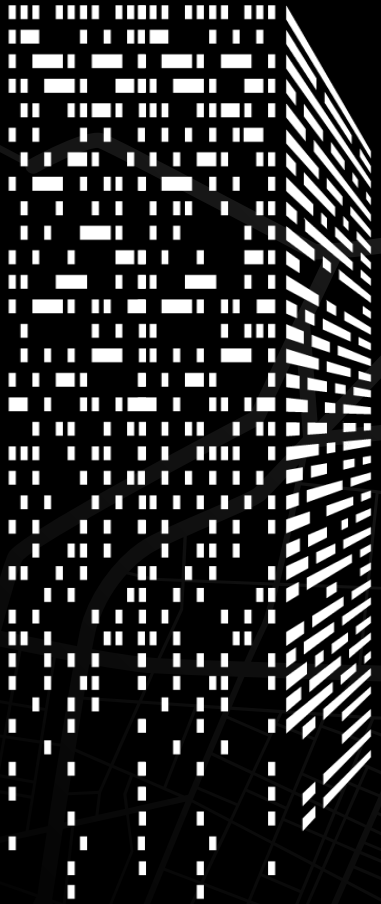
print_project_and_milestones
Retrieves and prints information about a given project and its milestones.

print_total_material_cost
Computes and prints the total cost of construction materials for a specific project

print_projects_and_challenges
Retrieves and prints information about all projects and their associated challenges,
sorted by project start date.

print_projects_by_material_cost
Retrieves and prints information about all projects, sorted by the total cost of construction materials used in descending order.

print_lowest_milestone_project_details
Retrieves and prints information about the architectural and engineering features and progress updates for the project with the fewest milestones.



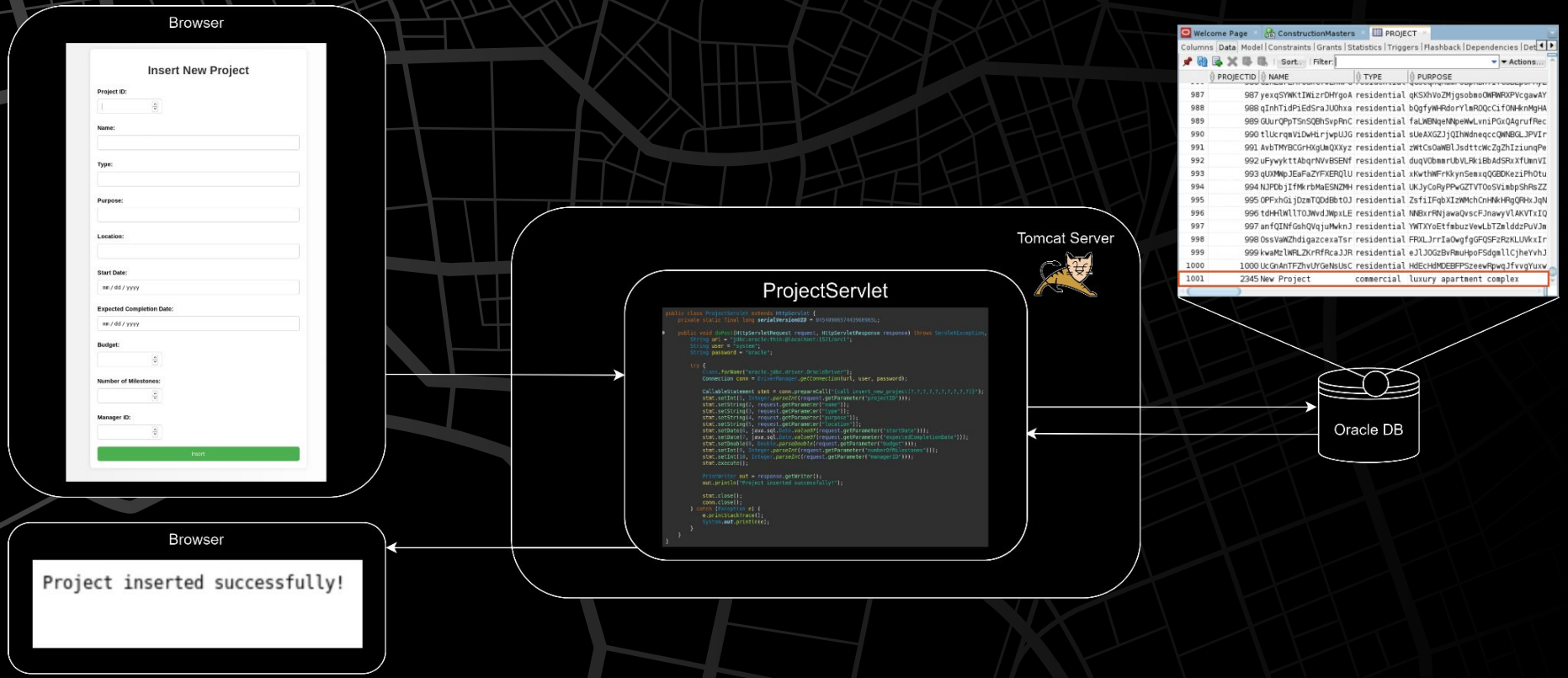
QUERY OPTIMIZATION

After populating the tables, three potential indexes were introduced to optimize operations 4, 5, and 6, but they were not utilized by the DBMS.

The decision of the DBMS to use or disregard user-defined indexes can hinge on multiple factors, such as table size, data distribution, and Oracle's Cost-Based Optimizer decisions, among other aspects.

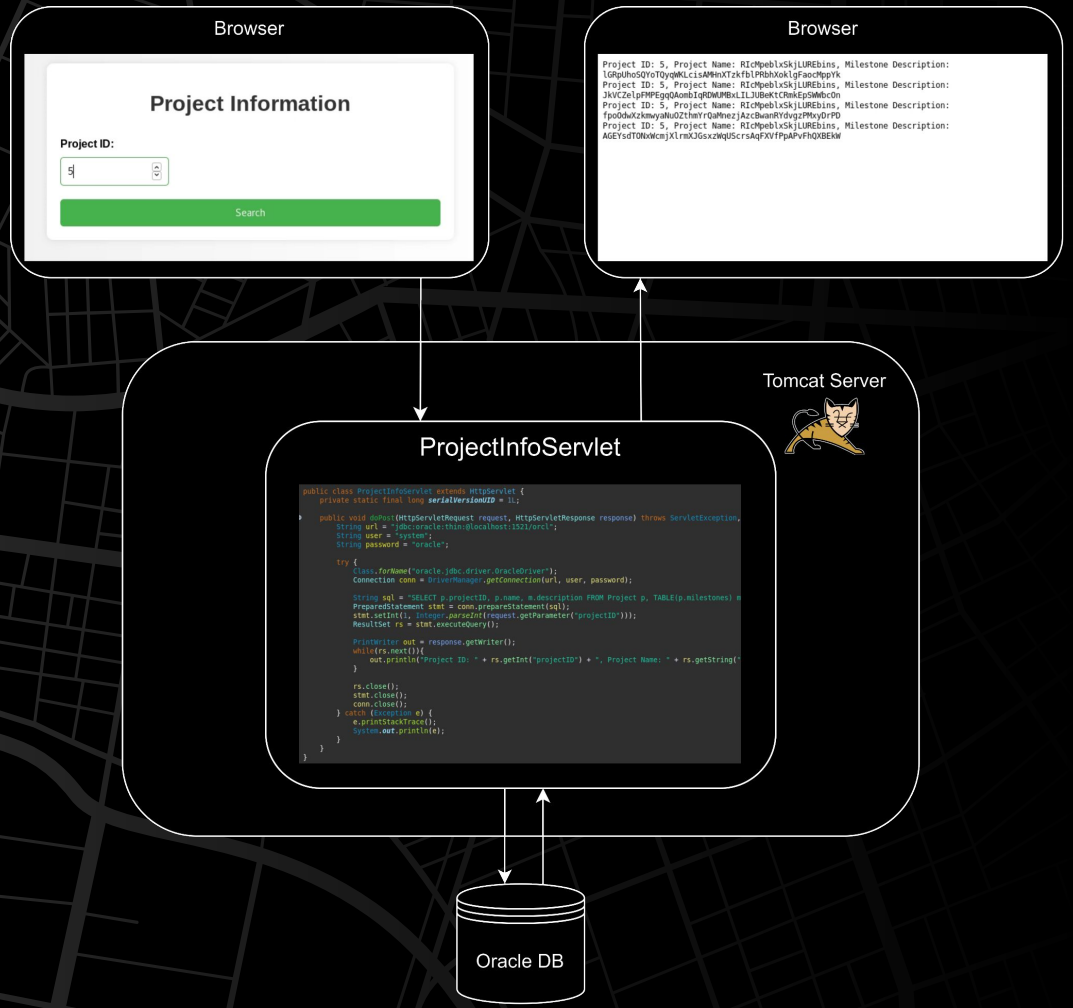
ProjectServlet

Implements operation number 1: inserting a new project into the database. Calls the stored procedure `insert_new_project`.



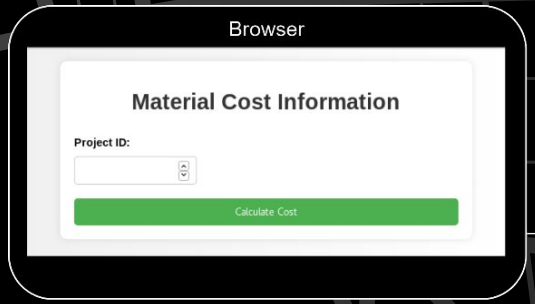
ProjectInfoServlet

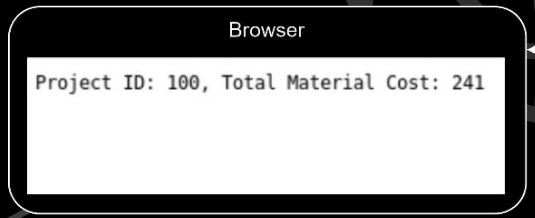
- Implements operation 2: retrieves and prints information about a given project and its milestones.
- Unlike the first servlet, it does not directly call a stored procedure.
- Instead, it reproduces the logic of print_project_and_milestones within the servlet itself due to the limitations of the DBMS_OUTPUT package.

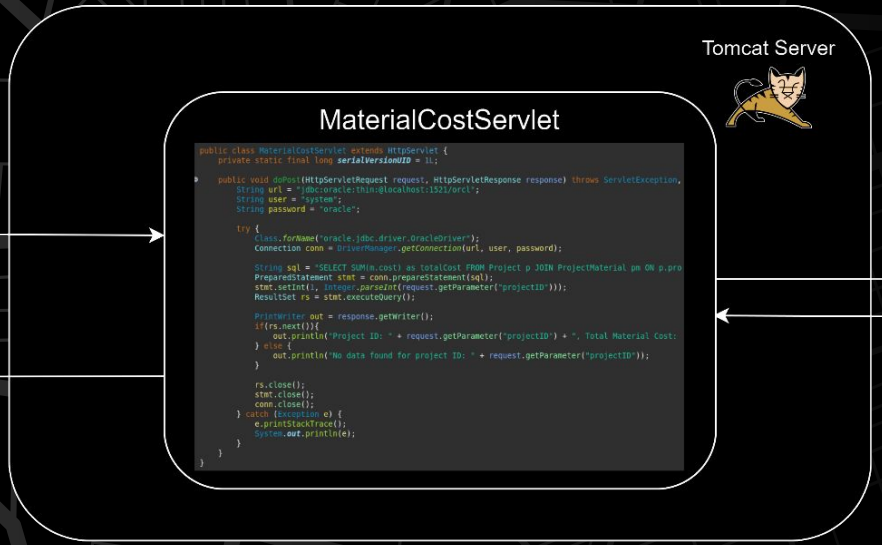


MaterialCostServlet

Implements operation number 3: calculating and displaying the total material cost for a specified project ID.

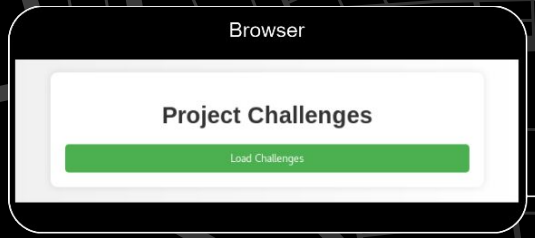


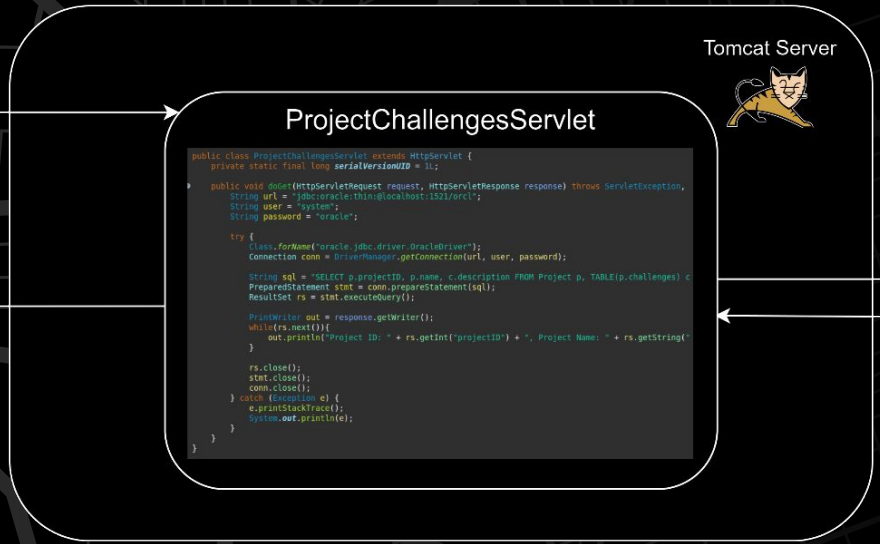




ProjectChallengesServlet

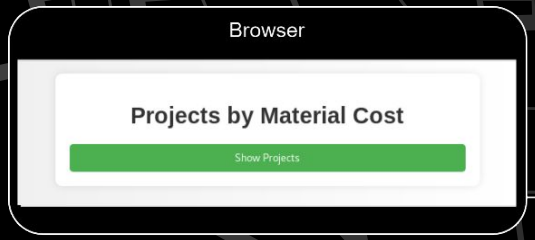
Implements operation 4: displays the challenges associated with each project.

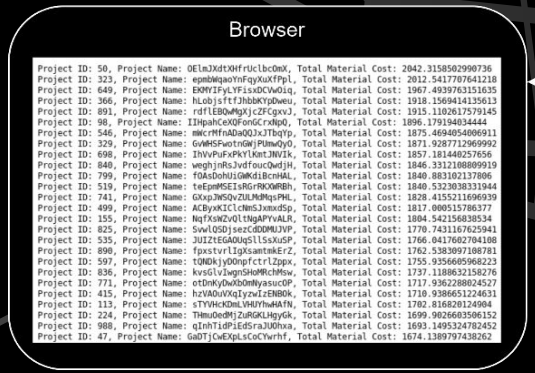


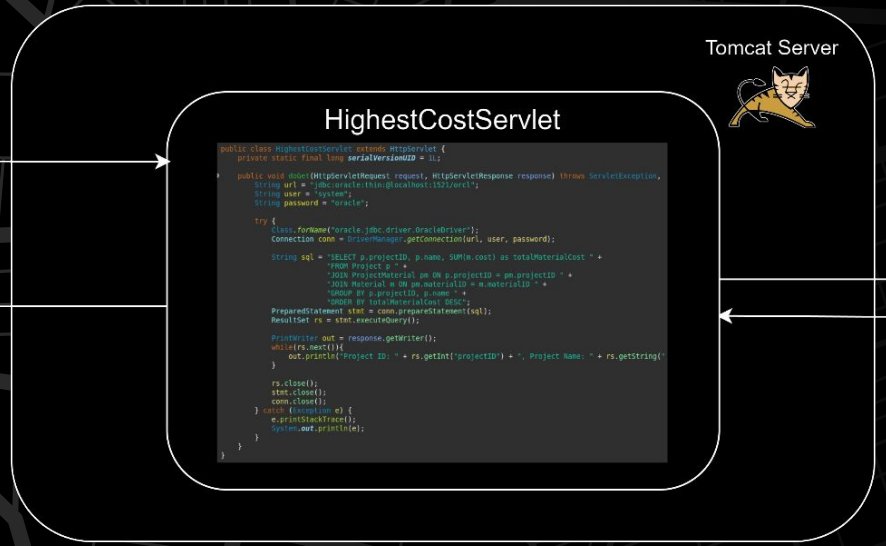


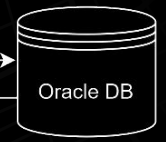
HighestCostServlet

Implements operation number 5: fetches the projects sorted by their total material cost.









LowestMilestoneProjectServlet

Implements operation number 6: displaying the architectural details, engineering specifications, and progress updates of the project with the fewest milestones.