

Material Procurement Management: A Database Design Case Study

Introduction

Material procurement is a vital process in the construction industry, responsible for acquiring necessary materials and ensuring that they are available when required. Managing procurement effectively involves tracking suppliers, managing inventory, and ensuring timely deliveries to avoid project delays. This case study demonstrates the development of a Material Procurement Management Database using database design principles to create an efficient system.

Mission

The mission of this database system is to streamline the procurement process by creating an efficient and scalable structure for managing materials, suppliers, inventory, and deliveries. The goal is to optimize resource allocation and ensure accurate and timely data to support decision-making in construction projects.

Objective

The primary objectives of this case study are:

1. To develop a comprehensive database system for managing procurement operations.
2. To ensure that the database structure is scalable and can handle the complexity of multiple projects, suppliers, and deliveries.
3. To provide accurate reports and real-time tracking of inventory, orders, and deliveries.
4. To ensure efficient data management through the use of relational database models.

Database Design

The design of the Material Procurement Management Database includes identifying key entities such as suppliers, materials, clients, employees, and projects, and defining the relationships between these entities. This allows the system to track procurement activities from supplier to project completion.

Why Database Design is Important

A well-structured database ensures that the material procurement process is smooth and efficient, reducing the risk of errors, delays, and resource misallocation. It also helps manage complex relationships between multiple suppliers, materials, and construction

projects. By creating a clear structure, the database improves data accuracy, supports reporting, and enhances decision-making.

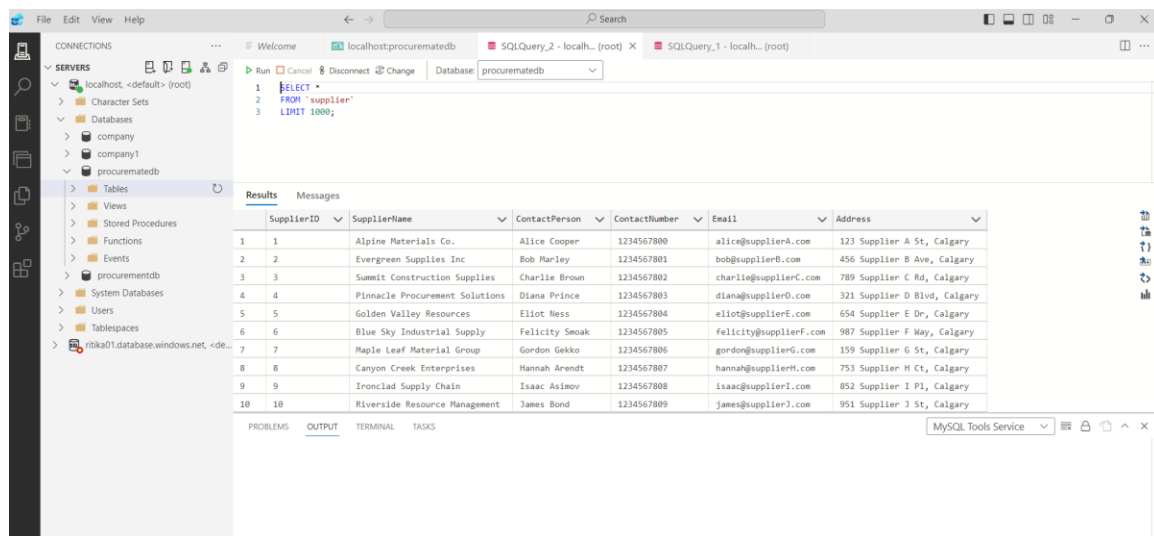
Database Structure: Key Entities and Their Tables

Supplier Table

This table holds information about the suppliers who provide materials for construction projects.

Attributes:

1. SupplierID (Primary Key)
2. SupplierName
3. ContactPerson
4. ContactNumber
5. Email (Unique)
6. Address



The screenshot shows the MySQL Tools Service interface. On the left, the 'CONNECTIONS' pane shows the 'procurematedb' database selected. The main window displays the 'Results' tab for a query: `SELECT * FROM 'supplier' LIMIT 1000;`. The results are shown in a table with 6 columns: SupplierID, SupplierName, ContactPerson, ContactNumber, Email, and Address. The data lists 10 suppliers.

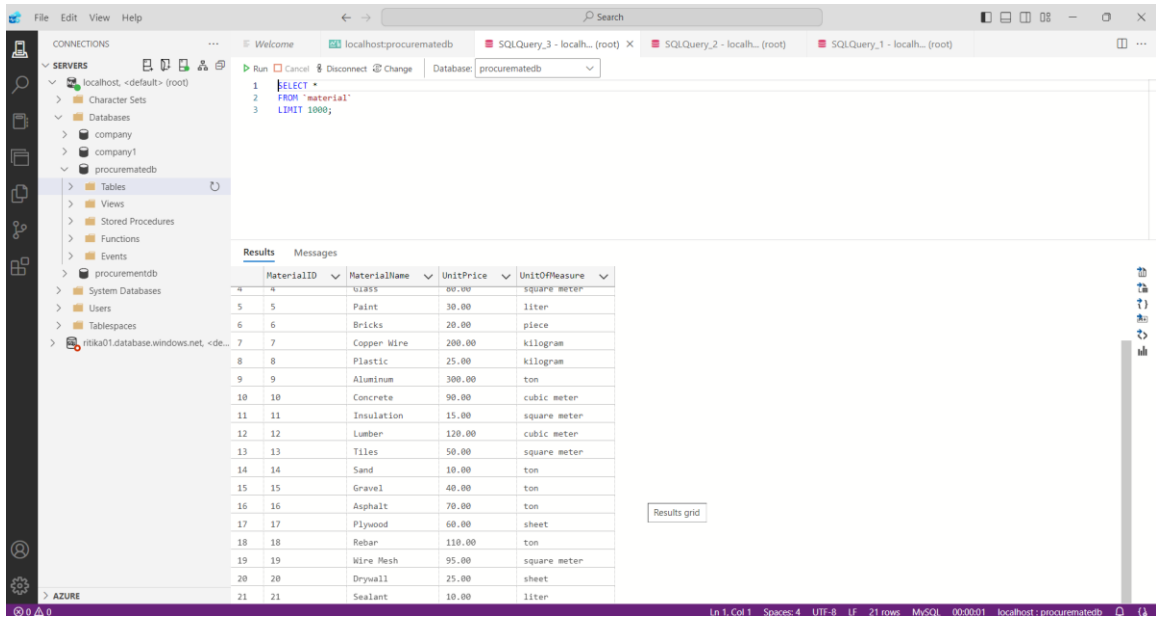
SupplierID	SupplierName	ContactPerson	ContactNumber	Email	Address
1	Alpine Materials Co.	Alice Cooper	1234567800	alice@supplierA.com	123 Supplier A St, Calgary
2	Evergreen Supplies Inc	Bob Harley	1234567801	bob@supplierB.com	456 Supplier B Ave, Calgary
3	Summit Construction Supplies	Charlie Brown	1234567802	charlie@supplierC.com	789 Supplier C Rd, Calgary
4	Pinnacle Procurement Solutions	Diana Prince	1234567803	diana@supplierD.com	321 Supplier D Blvd, Calgary
5	Golden Valley Resources	Eliot Ness	1234567804	eliot@supplierE.com	654 Supplier E Dr, Calgary
6	Blue Sky Industrial Supply	Felicity Smoak	1234567805	felicity@supplierF.com	987 Supplier F Way, Calgary
7	Maple Leaf Material Group	Gordon Gekko	1234567806	gordon@supplierG.com	159 Supplier G St, Calgary
8	Canyon Creek Enterprises	Hannah Arendt	1234567807	hannah@supplierH.com	753 Supplier H Ct, Calgary
9	Ironclad Supply Chain	Isaac Asimov	1234567808	isaac@supplierI.com	852 Supplier I Pl, Calgary
10	Riverside Resource Management	James Bond	1234567809	james@supplierJ.com	951 Supplier J St, Calgary

Material Table

The Material table stores details of the various materials used in construction.

Attributes:

1. MaterialID (Primary Key)
2. MaterialName
3. UnitPrice
4. UnitOfMeasure

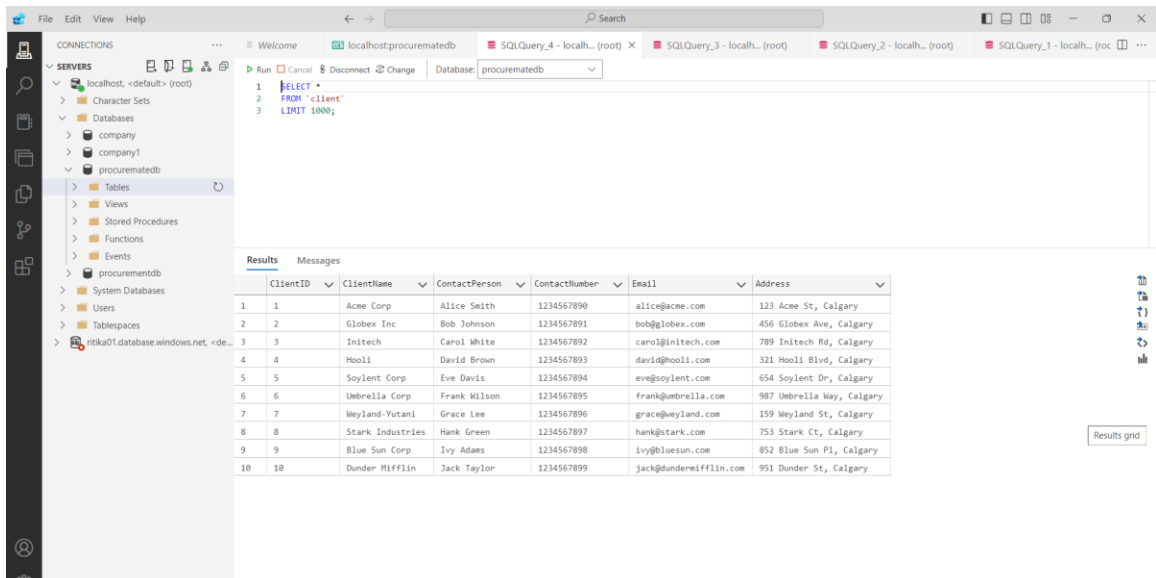


Client Table

Stores information about clients commissioning construction projects.

Attributes:

1. ClientID (Primary Key)
2. ClientName
3. ContactPerson
4. ContactNumber
5. Email
6. Address

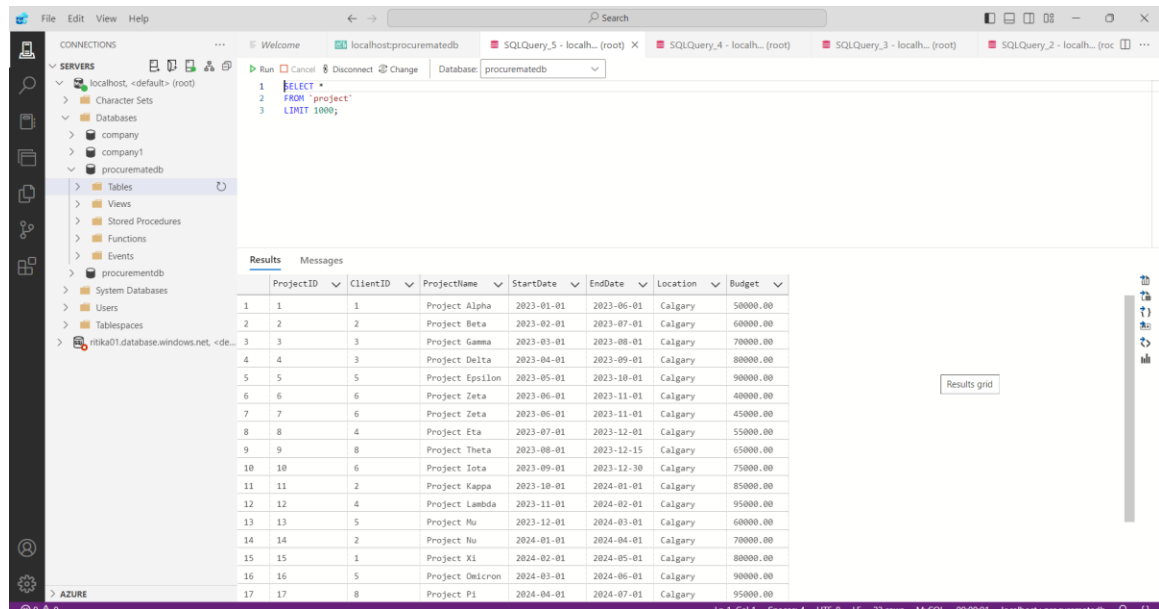


Project Table

Captures all details related to individual construction projects.

Attributes:

1. ProjectID (Primary Key)
2. ClientID (Foreign Key referencing Client)
3. ProjectName
4. StartDate
5. EndDate
6. Budget



SQL Query: `SELECT * FROM 'project' LIMIT 1000;`

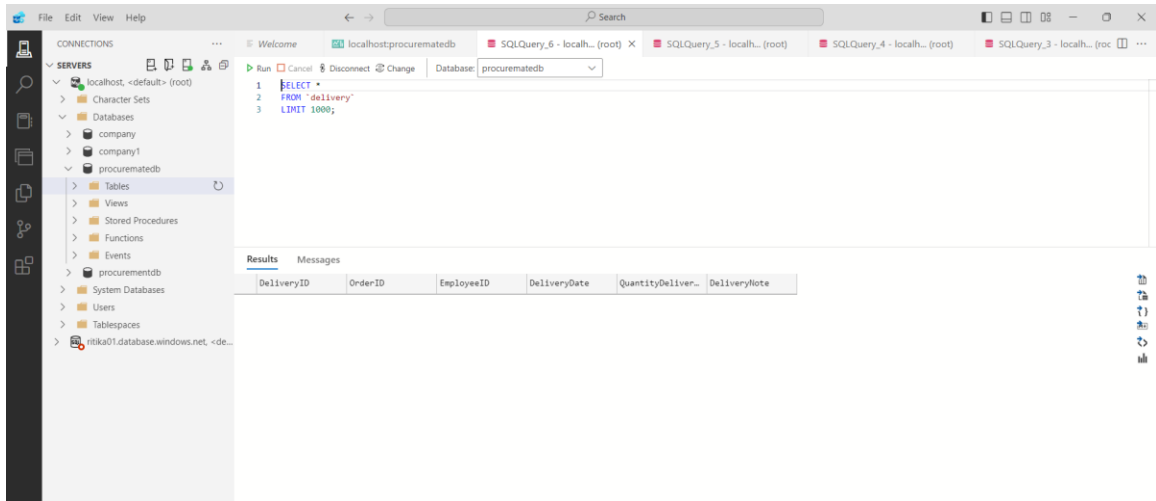
ProjectID	ClientID	ProjectName	StartDate	EndDate	Location	Budget
1	1	Project Alpha	2023-01-01	2023-06-01	Calgary	50000.00
2	2	Project Beta	2023-02-01	2023-07-01	Calgary	60000.00
3	3	Project Gamma	2023-03-01	2023-08-01	Calgary	70000.00
4	4	Project Delta	2023-04-01	2023-09-01	Calgary	80000.00
5	5	Project Epsilon	2023-05-01	2023-10-01	Calgary	90000.00
6	6	Project Zeta	2023-06-01	2023-11-01	Calgary	40000.00
7	7	Project Zeta	2023-06-01	2023-11-01	Calgary	45000.00
8	8	Project Eta	2023-07-01	2023-12-01	Calgary	55000.00
9	9	Project Theta	2023-08-01	2023-12-15	Calgary	65000.00
10	10	Project Iota	2023-09-01	2023-12-30	Calgary	75000.00
11	11	Project Kappa	2023-10-01	2024-01-01	Calgary	85000.00
12	12	Project Lambda	2023-11-01	2024-02-01	Calgary	95000.00
13	13	Project Mu	2023-12-01	2024-03-01	Calgary	60000.00
14	14	Project Nu	2024-01-01	2024-04-01	Calgary	70000.00
15	15	Project Xi	2024-02-01	2024-05-01	Calgary	80000.00
16	16	Project Omicron	2024-03-01	2024-06-01	Calgary	90000.00
17	17	Project Pi	2024-04-01	2024-07-01	Calgary	95000.00

Delivery Table

Tracks the delivery details for orders made to suppliers.

Attributes:

1. DeliveryID (Primary Key)
2. OrderID (Foreign Key referencing Order)
3. EmployeeID (Foreign Key referencing Employee)
4. DeliveryDate
5. QuantityDelivered
6. DeliveryNote

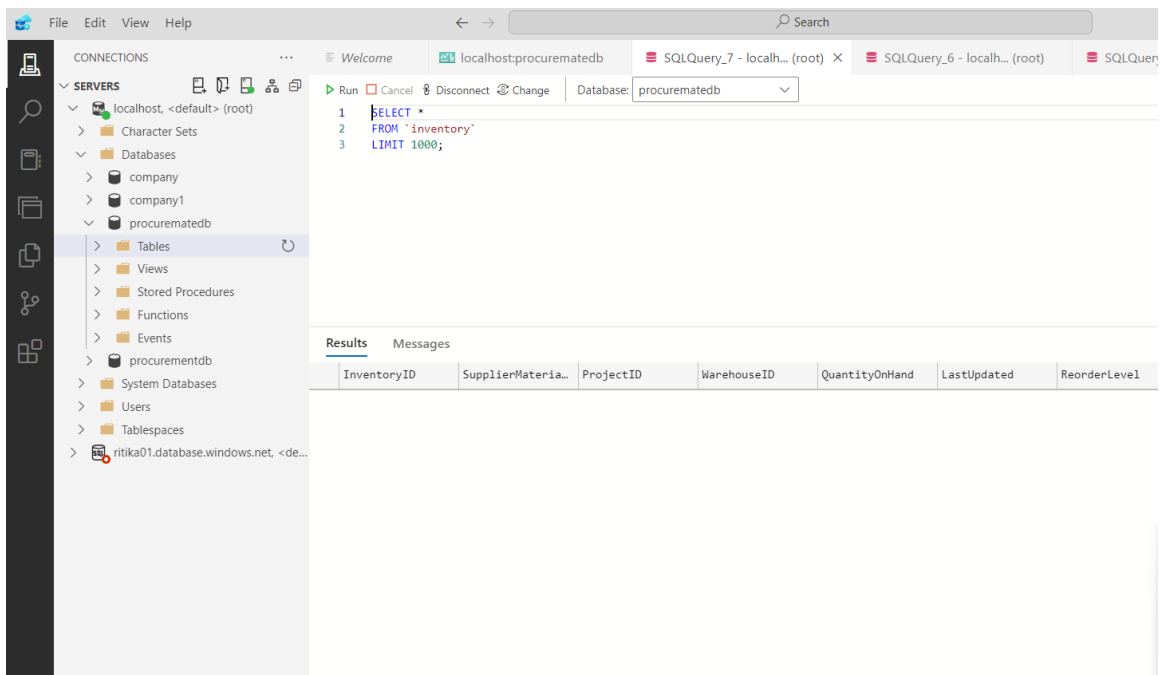


Inventory Table

Contains inventory information across different warehouse locations.

Attributes:

1. InventoryID (Primary Key)
2. SupplierMaterialID (Foreign Key referencing SupplierMaterial)
3. WarehouseID (Foreign Key referencing Warehouse)
4. QuantityOnHand
5. LastUpdated
6. ReorderLevel



Warehouse Table

Stores details about the warehouses that store materials.

Attributes:

1. WarehouseID (Primary Key)
2. WarehouseName
3. Location
4. Capacity

The screenshot shows the SQL Server Enterprise Manager interface. On the left, the 'Servers' tree is expanded to 'procuredatadb' > 'Tables'. The 'Tables' folder is selected. In the center, the 'SQLQuery_8 - localh... (root)' query window is open, showing a SQL query:

```
SELECT *
FROM 'warehouse'
LIMIT 1000;
```

 The 'Database' dropdown is set to 'procuredatadb'. Below the query window, the 'Results' tab is active, displaying the data from the 'Warehouse' table. The table has four columns: WarehouseID, WarehouseName, Location, and Capacity. The data is as follows:

WarehouseID	WarehouseName	Location	Capacity
1	Main Warehouse	123 Main St, Calgary	10000.00
2	East Warehouse	456 East St, Calgary	8000.00
3	West Warehouse	789 West St, Calgary	12000.00
4	North Warehouse	321 North St, Calgary	9000.00
5	South Warehouse	654 South St, Calgary	11000.00

Employee Table

Holds information about employees responsible for various tasks.

Attributes:

1. EmployeeID (Primary Key)
2. FirstName
3. LastName
4. Position
5. ContactNo
6. Email
7. DepartmentID (Foreign Key referencing Department)

Results grid

EmployeeID	FirstName	LastName	Position	ContactNo	Email	DepartmentID
1	John	Doe	Procurement Manager	1234567890	john.doe@example.com	1
2	Olivia	Taylor	Procurement Specialist	6789012345	olivia.taylor@example.com	1
3	Noah	Harris	Procurement Executive	2233445566	noah.harris@example.com	1
4	Ava	Martinez	Procurement Executive	3344556677	ava.martinez@example.com	1
5	Mason	Clark	Procurement Executive	4455667788	mason.clark@example.com	1
6	Isabella	Rodriguez	Procurement Executive	5566778899	isabella.rodriguez@example.com	1
7	Liam	Thompson	Procurement Executive	1122334455	liam.thompson@example.com	1
8	Sophia	Anderson	Procurement Executive	6677889901	sophia.anderson@example.com	1
9	Lucas	Johnson	Procurement Executive	7788990011	lucas.johnson@example.com	1
10	Mia	Wright	Procurement Executive	8899001122	mia.wright@example.com	1
11	Ella	Scott	Procurement Executive	9900112233	ella.scott@example.com	1
12	Jane	Smith	Financial Analyst	2345678901	jane.smith@example.com	2
13	Liam	Anderson	Finance Manager	7890123456	liam.anderson@example.com	2
14	James	Brown	Warehouse Supervisor	3456789012	james.brown@example.com	3
15	Sophia	Thomas	Warehouse Associate	8901234567	sophia.thomas@example.com	3
16	Emily	Davis	HR Coordinator	4567890123	emily.davis@example.com	4

Department Table

Stores information about the different departments employees belong to.

Attributes:

1. DepartmentID (Primary Key)
2. DepartmentName

Results grid

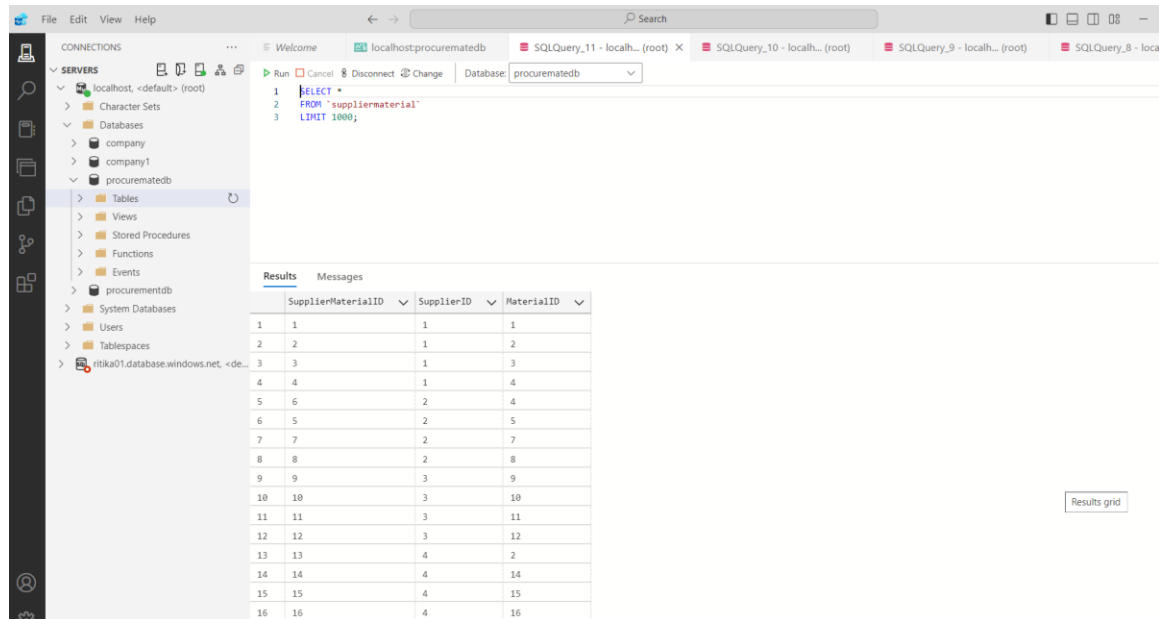
DepartmentID	DepartmentName
1	Procurement
2	Finance
3	Warehouse
4	Delivery
5	Quality Control
6	Procurement
7	Finance
8	Warehouse
9	Human Resource
10	Quality Control

SupplierMaterial Table

Contains information about materials supplied by different suppliers.

Attributes:

1. SupplierMaterialID (Primary Key)
2. SupplierID (Foreign Key referencing Supplier)
3. MaterialID (Foreign Key referencing Material)



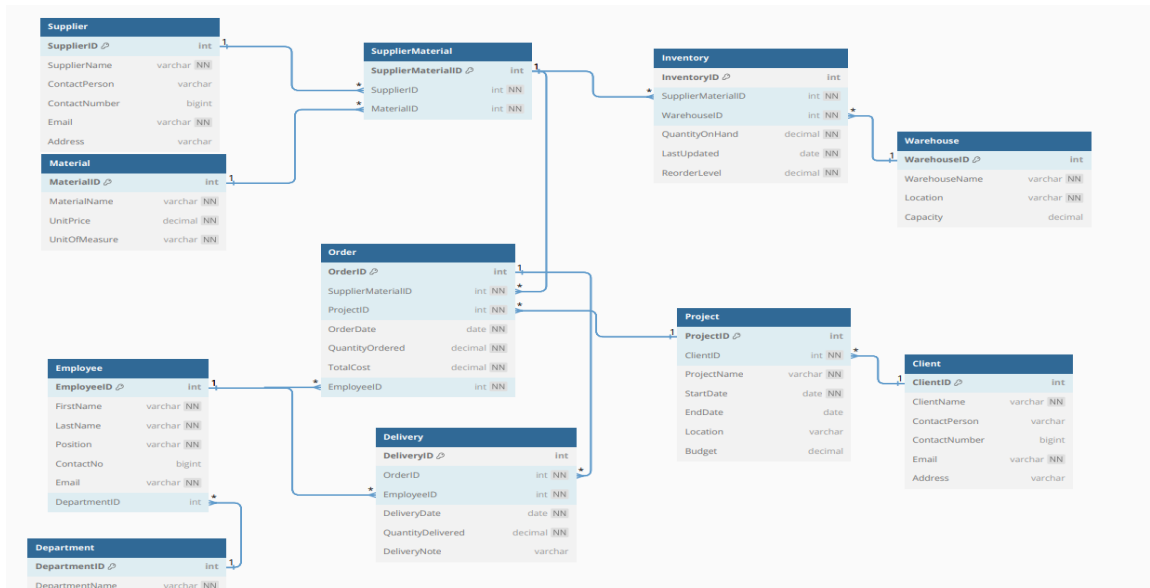
Entity Relationships

The database design includes various relationships that help in managing the procurement process efficiently:

1. Client to Project: One client can have multiple projects (One-to-Many).
2. Supplier to Material: One supplier can provide multiple materials, and one material can come from multiple suppliers (Many-to-Many).
3. Warehouse to Inventory: A warehouse can store multiple inventories (One-to-Many).
4. Project to Order: Each project can generate multiple orders (One-to-Many).

ER Diagram

The ER diagram visually represents how the entities (tables) are related to one another, ensuring smooth data flow between entities.



Why This Structure?

The chosen database structure supports the efficient handling of complex relationships and data within the procurement process. This design ensures that:

1. Data integrity is maintained through primary and foreign keys.
2. Complex relationships are represented using relational models.
3. Scalability is achieved by allowing new entities or relationships to be easily added.

Conclusion

The Material Procurement Management System is essential for any construction company aiming to streamline its procurement process. A well-designed database ensures data accuracy, reduces delays, and improves resource allocation, ultimately contributing to the success of construction projects.

Appendix A - Table Details

1. Supplier Table: Detailed information about suppliers.
2. Client Table: Information on clients commissioning projects.
3. Material Table: Detailed material information.
4. Project Table: All relevant project data.
5. Employee Table: Details of employees handling procurement.
6. Order Table: Tracks procurement orders.

Appendix B - Test Queries (Sample MySQL)

1. Query to Find Suppliers for a Specific Material:

```
```sql
```

```

SELECT SupplierName
FROM Supplier
JOIN SupplyMaterial ON Supplier.SupplierID = SupplyMaterial.SupplierID
WHERE MaterialID = (SELECT MaterialID FROM Material WHERE MaterialName =
'Steel');
'''

```

2. Query to Track Orders for a Specific Project:

```

'''sql
SELECT OrderID, ProjectID, QuantityOrdered, TotalCost
FROM Orders
WHERE ProjectID = 22;
'''

```

3. Query to Track Deliveries for a Specific Order:

```

'''sql
SELECT DeliveryID, OrderID, QuantityDelivered, DeliveryDate
FROM Delivery
WHERE OrderID = 31;
'''

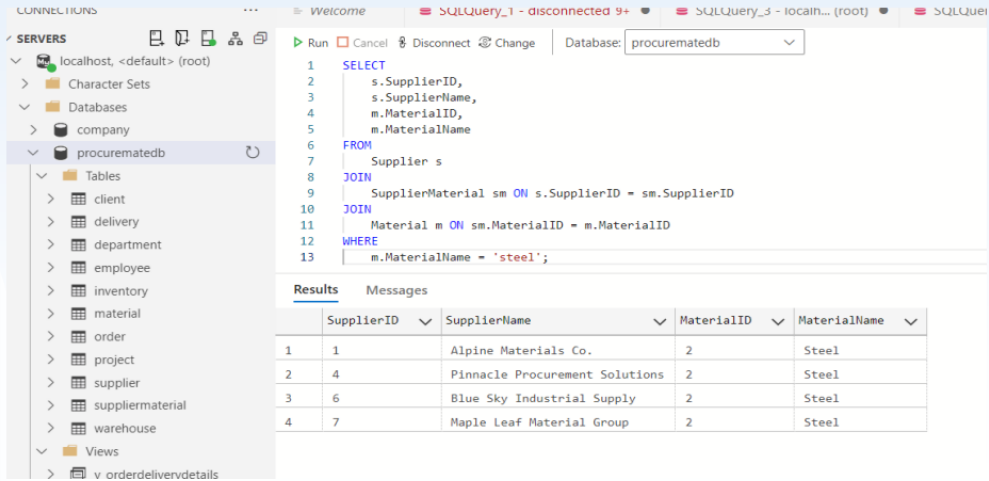
```

## Screenshots of Join Queries

### Query 1: Identify Suppliers for Specific Material (Steel)

This query identifies suppliers who provide steel material. The SQL code and its result are shown below.

**Query 1:**  
Identify Suppliers for Specific Material (ex :steel)



The screenshot shows the SQL Server Enterprise Manager interface. On the left, the 'Servers' tree is expanded to show the 'procurematadb' database. The 'Tables' folder is expanded, showing a list of tables including 'client', 'delivery', 'department', 'employee', 'inventory', 'material', 'order', 'project', 'supplier', 'suppliermaterial', and 'warehouse'. The 'suppliermaterial' table is selected. In the center, the SQL query is displayed in the 'SQLQuery\_1' window. The query is a SELECT statement that joins the 'Supplier' table (s) with the 'SupplierMaterial' table (sm) on 'SupplierID', and the 'Material' table (m) on 'MaterialID'. The 'WHERE' clause filters for 'MaterialName = 'steel''. The results are shown in a table at the bottom right.

```

1 SELECT
2 s.SupplierID,
3 s.SupplierName,
4 m.MaterialID,
5 m.MaterialName
6 FROM
7 Supplier s
8 JOIN
9 SupplierMaterial sm ON s.SupplierID = sm.SupplierID
10 JOIN
11 Material m ON sm.MaterialID = m.MaterialID
12 WHERE
13 m.MaterialName = 'steel';

```

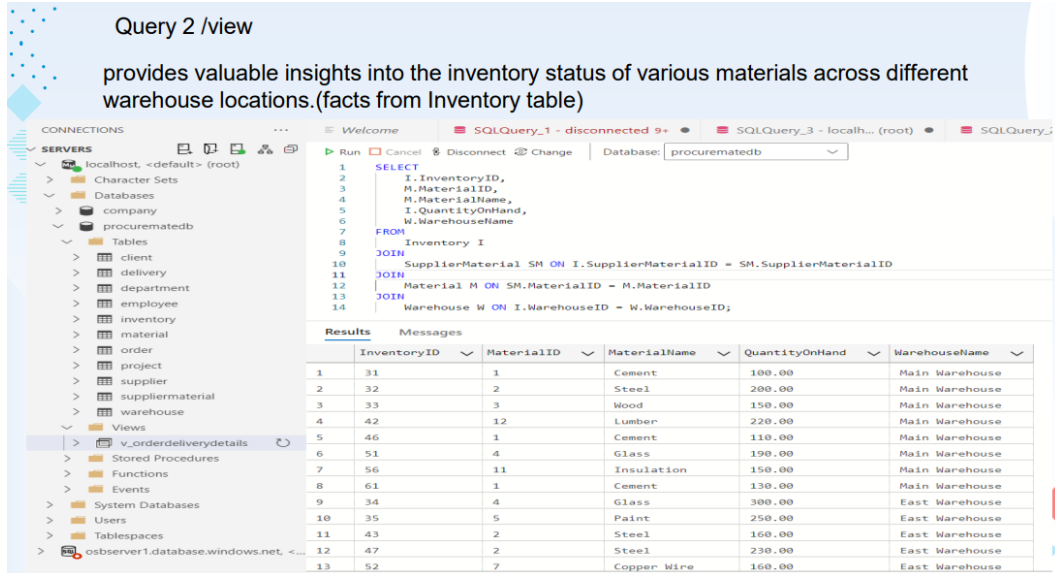
	SupplierID	SupplierName	MaterialID	MaterialName
1	1	Alpine Materials Co.	2	Steel
2	4	Pinnacle Procurement Solutions	2	Steel
3	6	Blue Sky Industrial Supply	2	Steel
4	7	Maple Leaf Material Group	2	Steel

## Query 2: View Inventory Status

This query shows the inventory status of materials across warehouse locations.

Query 2 /view

provides valuable insights into the inventory status of various materials across different warehouse locations.(facts from Inventory table)



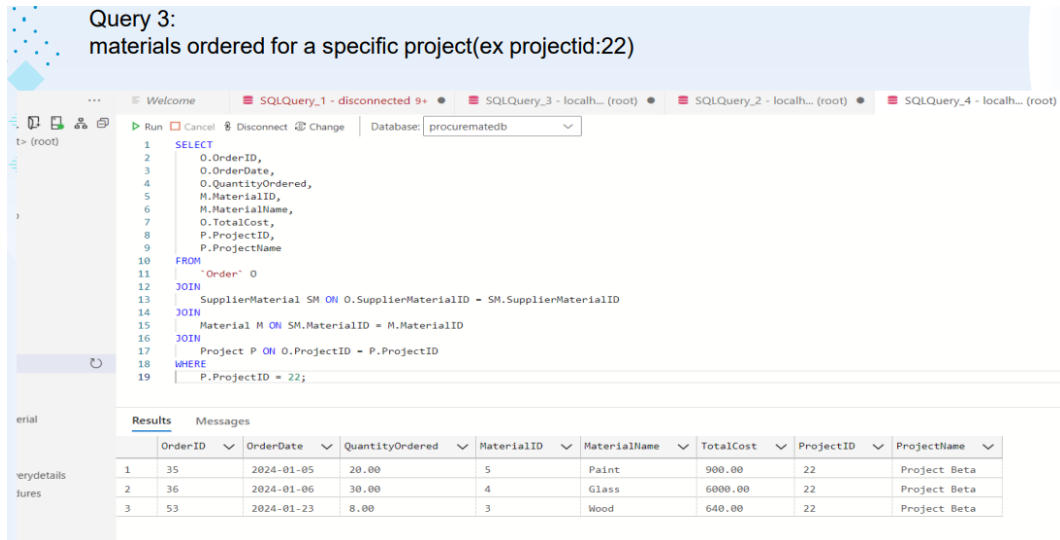
```
SELECT
1 I.InventoryID,
2 M.MaterialID,
3 M.MaterialName,
4 I.QuantityOnHand,
5 W.WarehouseName
6 FROM
7 Inventory I
8 JOIN
9 SupplierMaterial SM ON I.SupplierMaterialID = SM.SupplierMaterialID
10 JOIN
11 Material M ON SM.MaterialID = M.MaterialID
12 JOIN
13 Warehouse W ON I.WarehouseID = W.WarehouseID;
```

InventoryID	MaterialID	MaterialName	QuantityOnHand	WarehouseName
1	31	Cement	100.00	Main Warehouse
2	32	Steel	200.00	Main Warehouse
3	33	Wood	150.00	Main Warehouse
4	42	Lumber	220.00	Main Warehouse
5	46	Cement	110.00	Main Warehouse
6	51	Glass	190.00	Main Warehouse
7	56	Insulation	150.00	Main Warehouse
8	61	Cement	130.00	Main Warehouse
9	34	Glass	300.00	East Warehouse
10	35	Paint	250.00	East Warehouse
11	43	Steel	160.00	East Warehouse
12	47	Steel	230.00	East Warehouse
13	52	Copper Wire	160.00	East Warehouse

## Query 3: Materials Ordered for a Specific Project

This query retrieves all materials ordered for a specific project (e.g., Project ID 22).

Query 3:  
materials ordered for a specific project(ex projectid:22)



```
SELECT
1 O.OrderID,
2 O.OrderDate,
3 O.QuantityOrdered,
4 M.MaterialID,
5 M.MaterialName,
6 O.TotalCost,
7 P.ProjectID,
8 P.ProjectName
9 FROM
10 'Order' O
11 JOIN
12 SupplierMaterial SM ON O.SupplierMaterialID = SM.SupplierMaterialID
13 JOIN
14 Material M ON SM.MaterialID = M.MaterialID
15 JOIN
16 Project P ON O.ProjectID = P.ProjectID
17 WHERE
18 P.ProjectID = 22;
```

OrderID	OrderDate	QuantityOrdered	MaterialID	MaterialName	TotalCost	ProjectID	ProjectName	
1	35	2024-01-05	20.00	5	Paint	900.00	22	Project Beta
2	36	2024-01-06	30.00	4	Glass	6000.00	22	Project Beta
3	53	2024-01-23	8.00	3	Wood	640.00	22	Project Beta

## Query 4: Track Deliveries for a Specific Order

This query tracks all deliveries made for a specific order (e.g., Order ID 31).