ARCHITECTURAL FIRM MANAGEMENT SYSTEM

CS457 Signature Project

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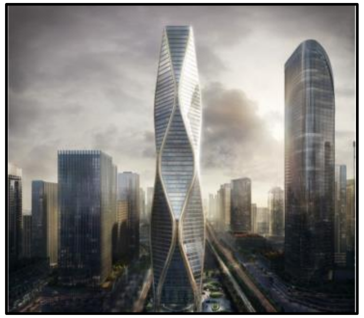

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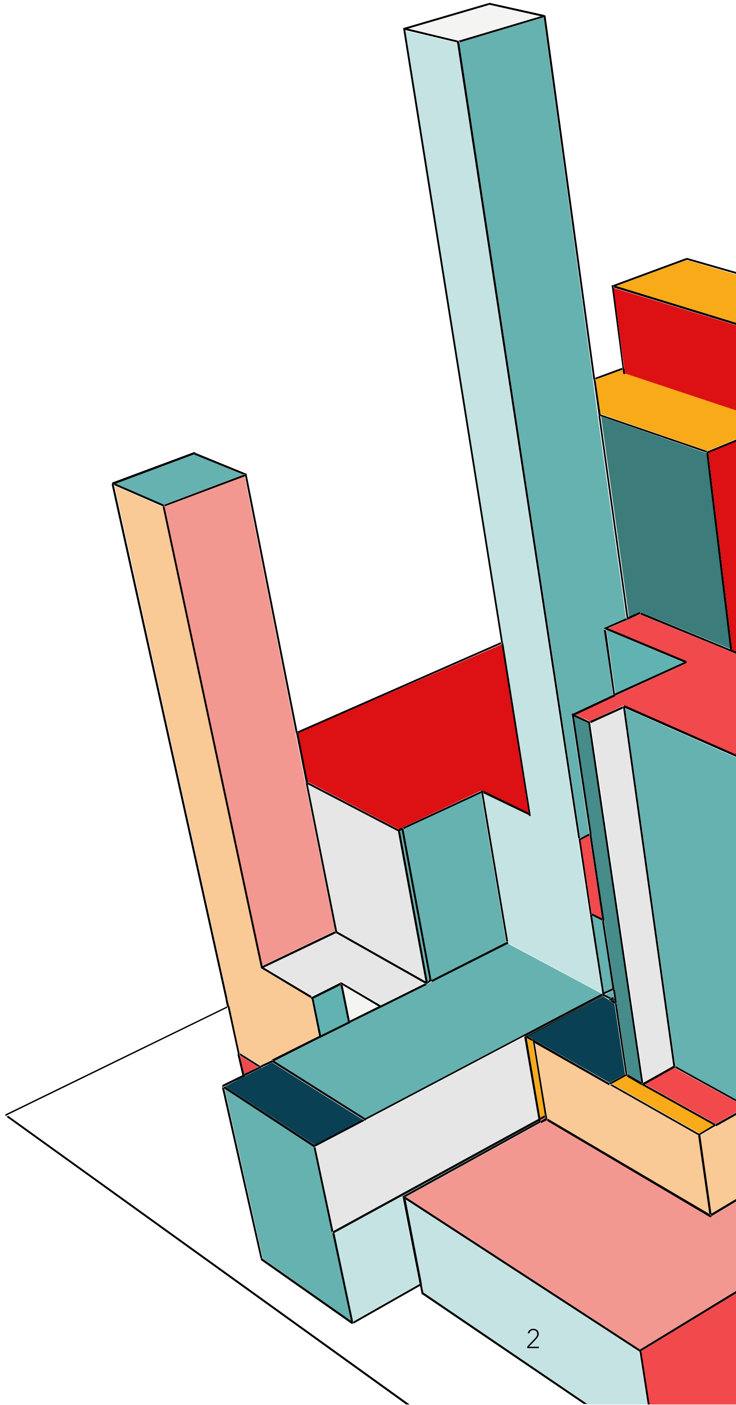
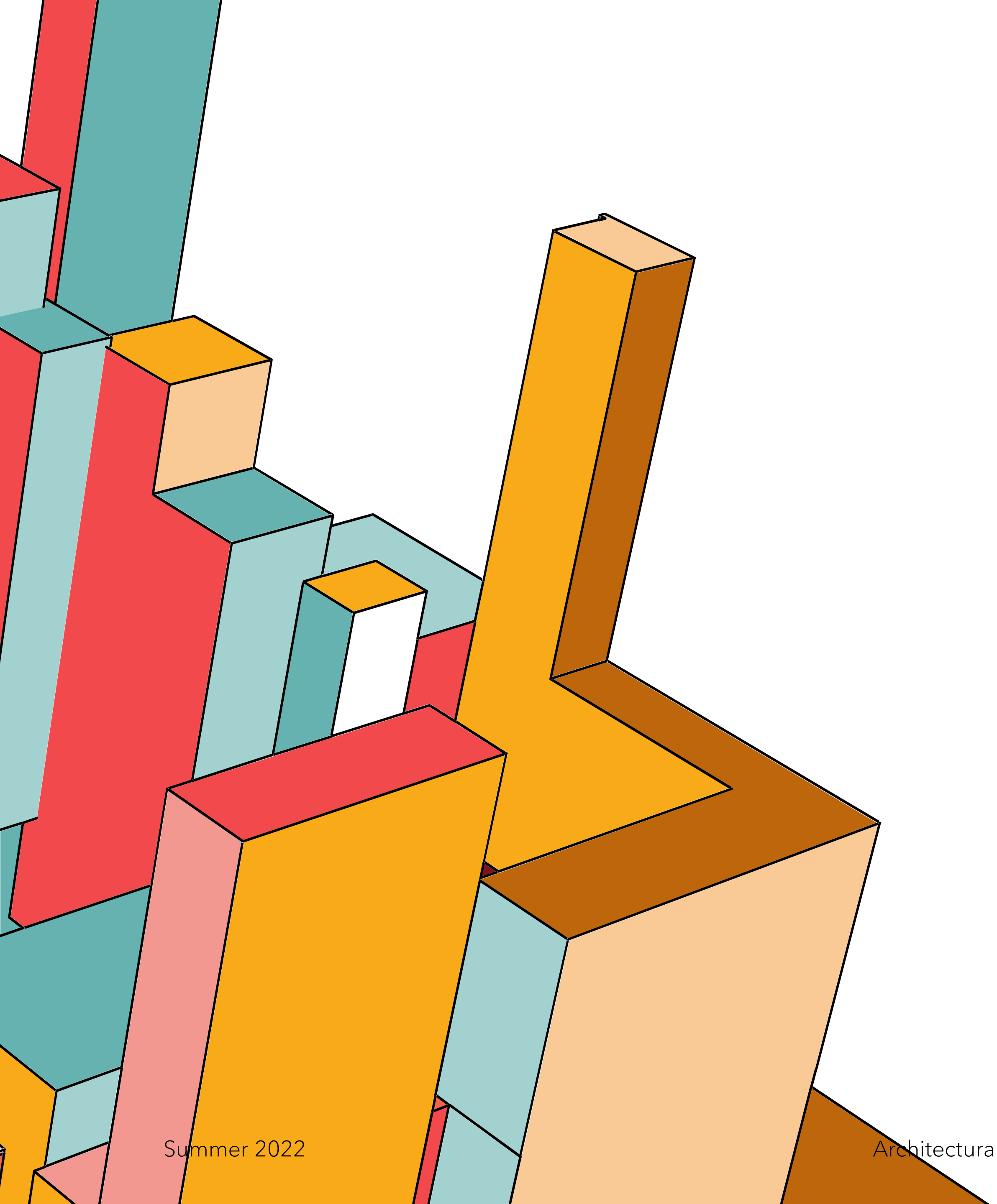




INTRODUCTION

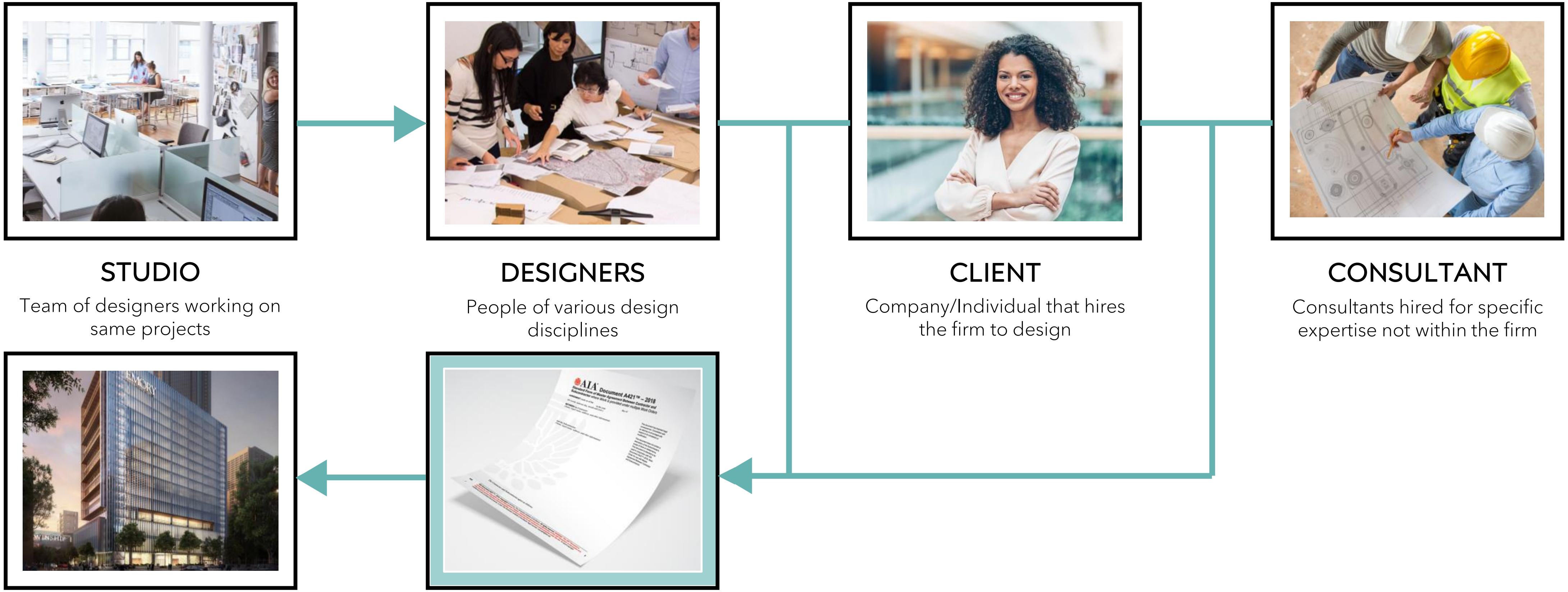
THE ARCHITECTURE FIRM MANAGEMENT SYSTEM

is a human resource and project management system that manages:

- Studios
- Designers
- Clients
- Consultants
- Buildings
- Contracts

To understand how an architecture firm usually works, let’s look at who or what each entity is. Understanding the important components of an architecture firm will help us visualize the Entity Relationship Model that represents the management system.

MEET THE ARCHITECTURAL FIRM



STUDIO

Team of designers working on same projects

DESIGNERS

People of various design disciplines

CLIENT

Company/Individual that hires the firm to design

CONSULTANT

Consultants hired for specific expertise not within the firm

BUILDING

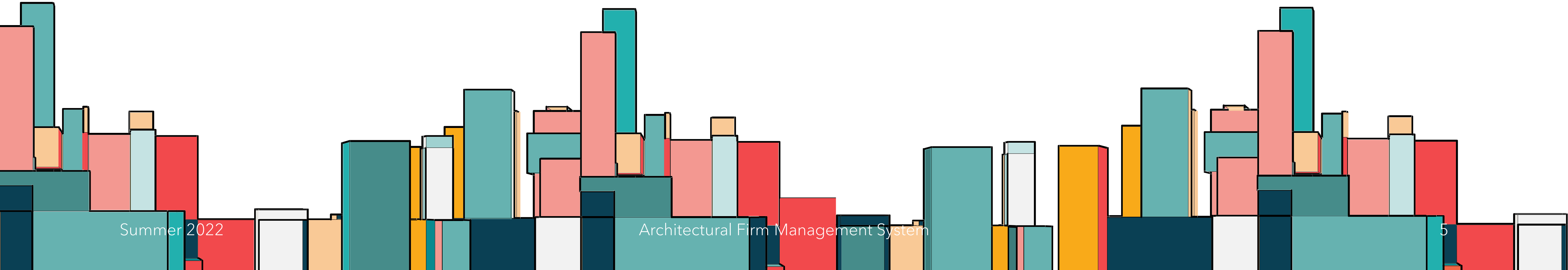
The project's physical end-product

CONTRACT

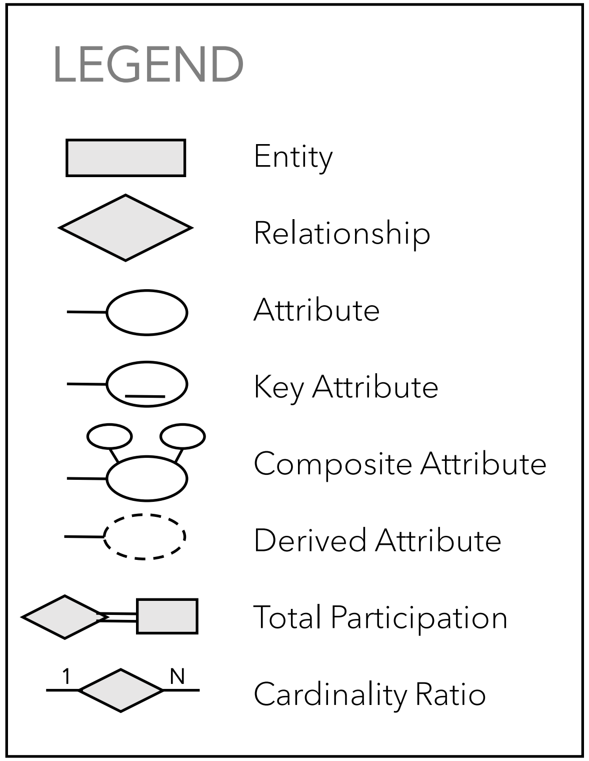
Agreement between parities of a project

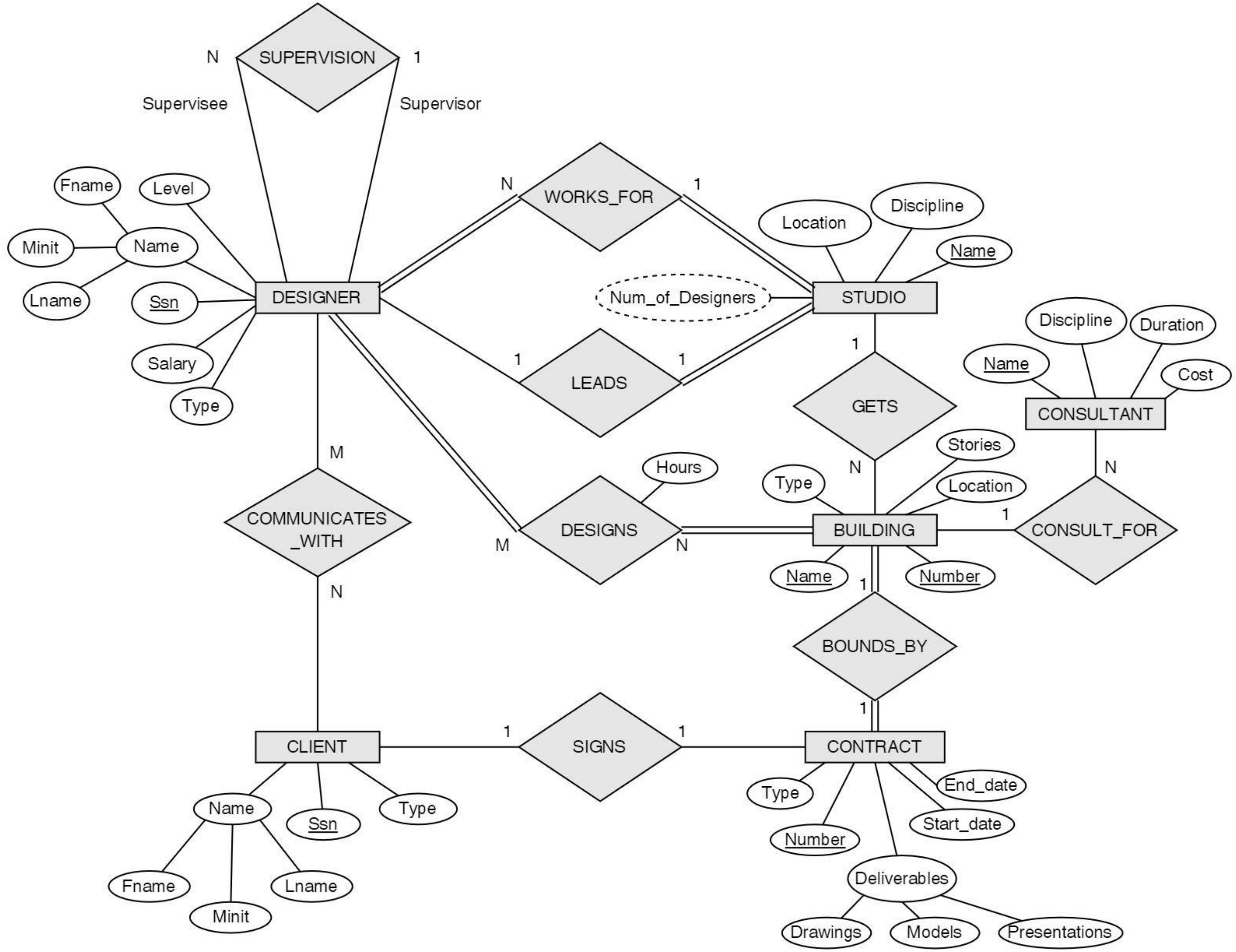
ENTITY RELATIONSHIP MODEL

- The ER diagrams shows how the schema for this architecture firm database application is displayed using means of graphical notion.
- The ER Model describes data as *entities, relationships, and attributes*.
- The basic concept that the ER model represents is an **entity**, which is a thing or object in the real world with an independent existence.
- Each entity has **attributes** – the particular properties that describe it.
- **Relationships** exist among various entity types whenever an attribute of one entity type refers to another entity type, could be binary or ternary.



ENTITY RELATION DIAGRAM

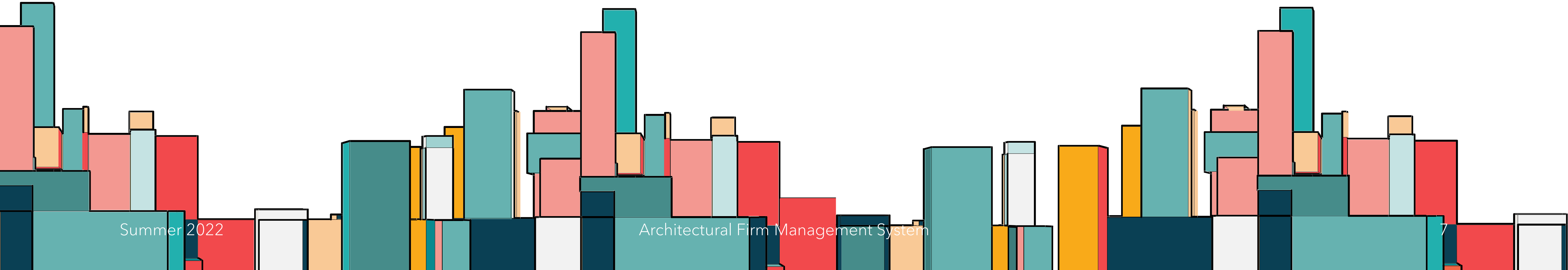


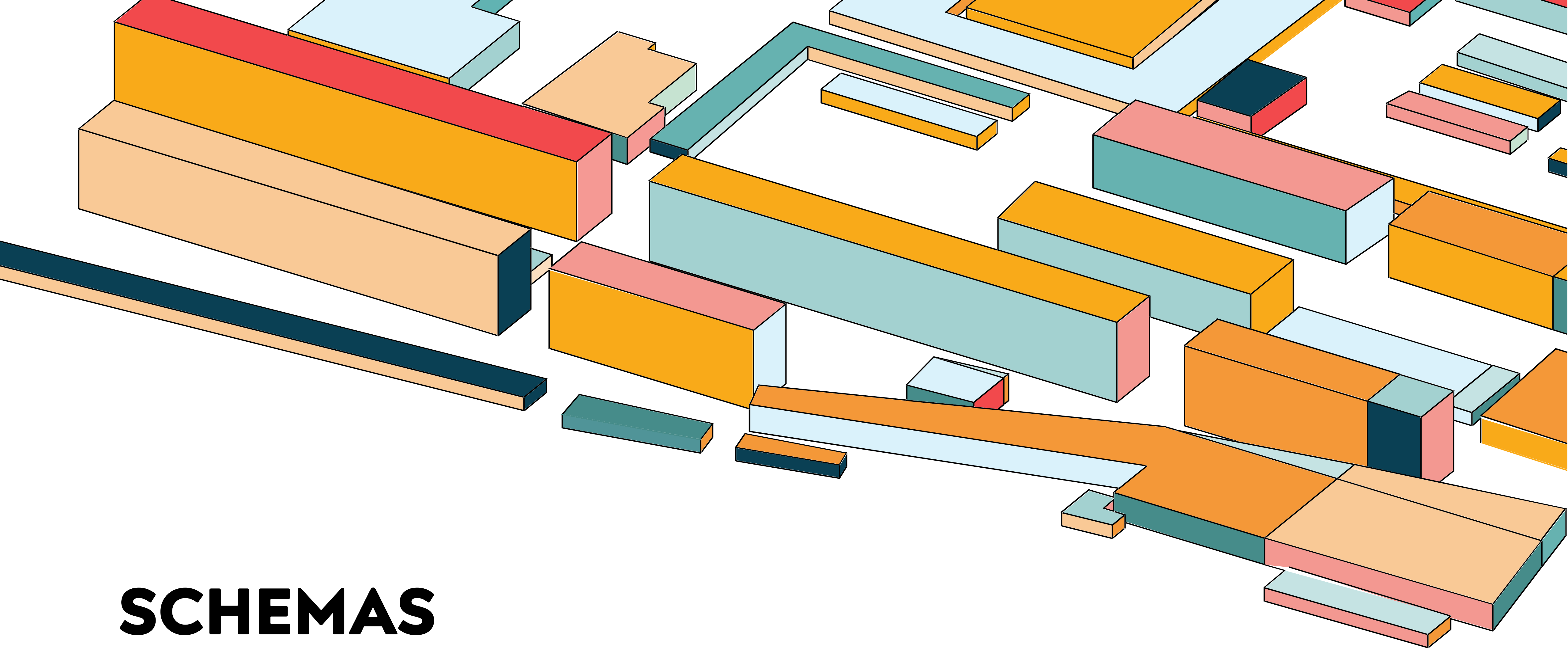


ER DIAGRAM EXPLANATION

RELATIONSHIP AND CARDINALITY CONSTRAINTS

- Specify(N, 1) for total participation of DESIGNER in WORKS_FOR: studio can have multiple designers
- Specify(1, 1) for participation of DESIGNER in LEADS: each studio can have only one leader
- Specify(M, N) for participation of DEISNGER in COMMUNICATES_WITH: designers can communicate with multiple clients
- Specify(1, N) for participation of DESIGNER in SUPERVISION: many designers are supervised by one supervisor
- Specify(1, 1) for participation of CLIENT in SIGNS: each client signs one contract
- Specify(1, 1) for total participation of BUILDING in BOUNDS_BY: each building is bounded by one contract
- Specify(1, N) for participation of STUDIO in GETS: each studio gets multiple building projects
- Specify(1, N) for participation of CONSULTANT in CONSULTS_FOR: many consultants can consult for one building project

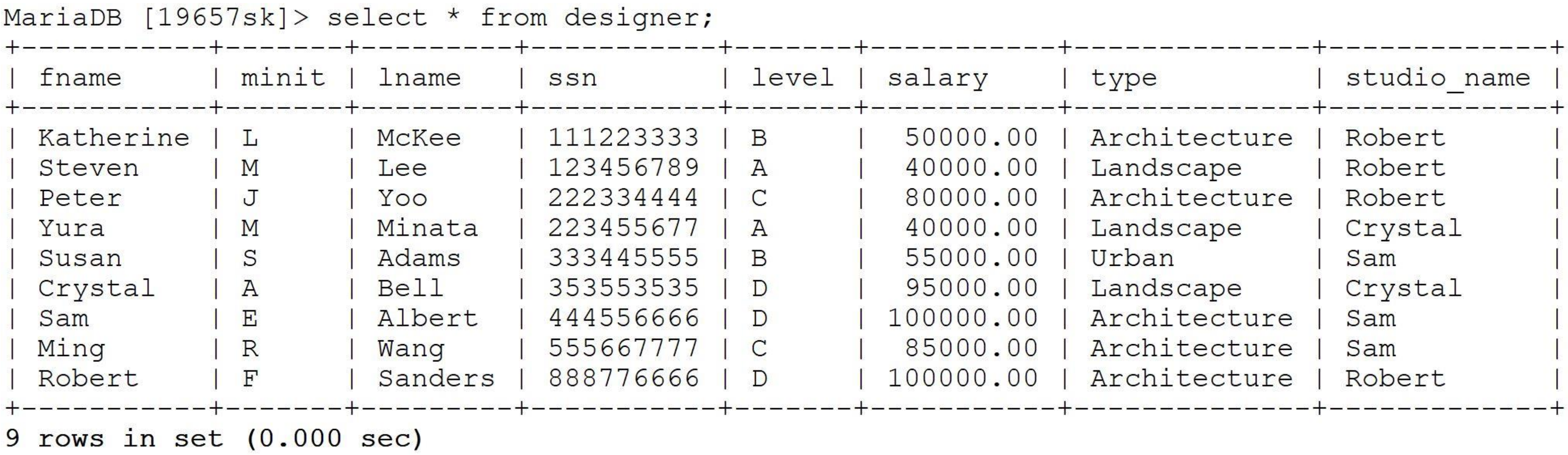




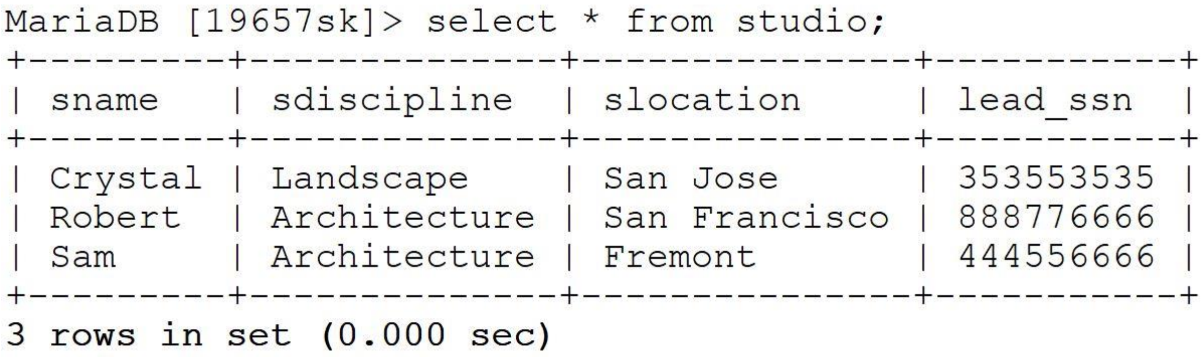
SCHEMAS

A database schema defines how data is organized within a relational database; this is inclusive of logical constraints such as, table names, fields, data types, and the relationships between these entities.

SCHEMAS

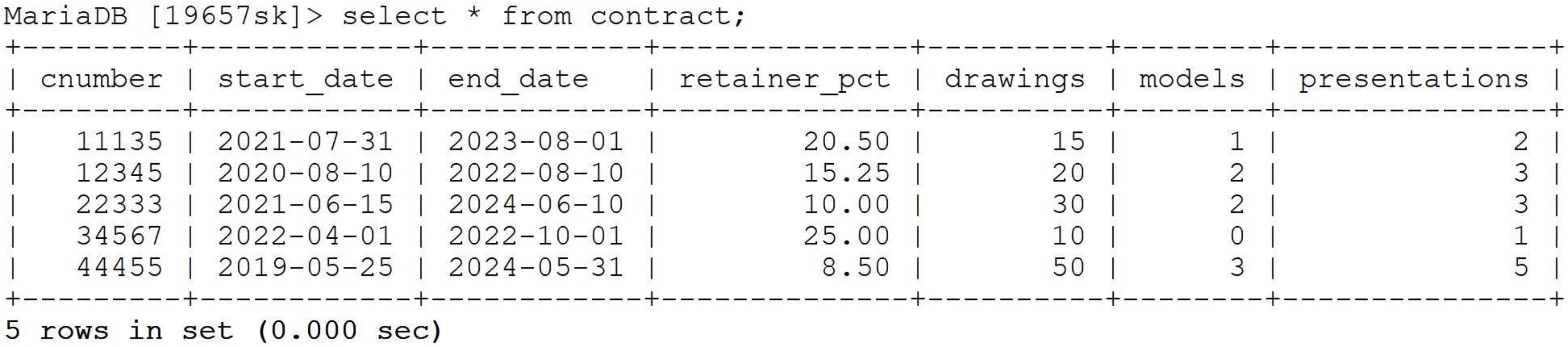


```
MariaDB [19657sk]> select * from designer;
+-----------+-------+---------+-----------+-------+-----------+--------------+-------------+
| fname     | minit | lname   | ssn       | level | salary    | type         | studio_name |
+-----------+-------+---------+-----------+-------+-----------+--------------+-------------+
| Katherine | L     | McKee   | 111223333 | B     |  50000.00 | Architecture | Robert      |
| Steven    | M     | Lee     | 123456789 | A     |  40000.00 | Landscape    | Robert      |
| Peter     | J     | Yoo     | 222334444 | C     |  80000.00 | Architecture | Robert      |
| Yura      | M     | Minata  | 223455677 | A     |  40000.00 | Landscape    | Crystal     |
| Susan     | S     | Adams   | 333445555 | B     |  55000.00 | Urban        | Sam         |
| Crystal   | A     | Bell    | 353553535 | D     |  95000.00 | Landscape    | Crystal     |
| Sam       | E     | Albert  | 444556666 | D     | 100000.00 | Architecture | Sam         |
| Ming      | R     | Wang    | 555667777 | C     |  85000.00 | Architecture | Sam         |
| Robert    | F     | Sanders | 888776666 | D     | 100000.00 | Architecture | Robert      |
+-----------+-------+---------+-----------+-------+-----------+--------------+-------------+
9 rows in set (0.000 sec)
```

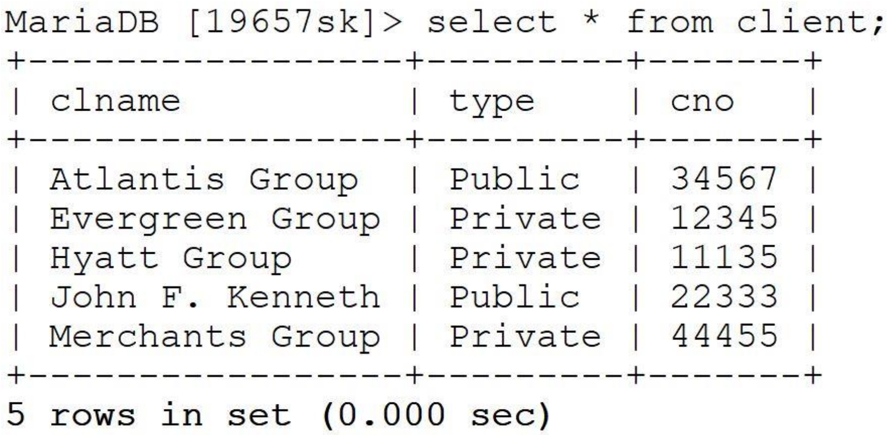


```
MariaDB [19657sk]> select * from studio;
+---------+--------------+---------------+-----------+
| sname   | sdiscipline  | slocation     | lead_ssn  |
+---------+--------------+---------------+-----------+
| Crystal | Landscape    | San Jose      | 353553535 |
| Robert  | Architecture | San Francisco | 888776666 |
| Sam     | Architecture | Fremont       | 444556666 |
+---------+--------------+---------------+-----------+
3 rows in set (0.000 sec)
```

SCHEMAS

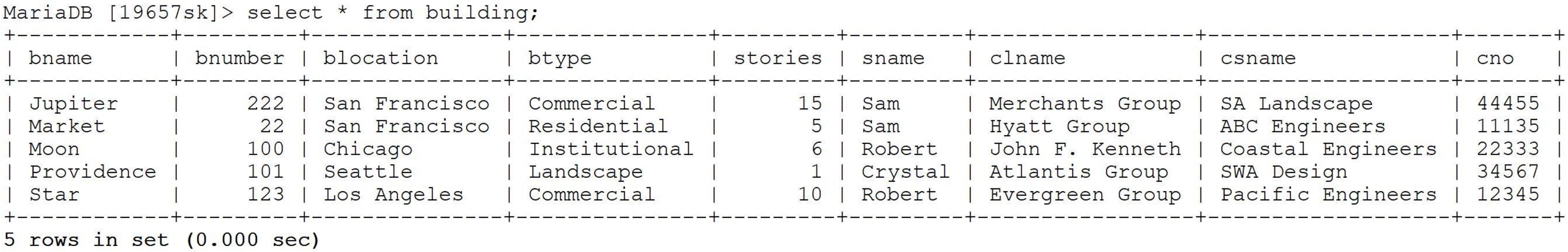


```
MariaDB [19657sk]> select * from contract;
+---------+------------+------------+--------------+----------+--------+---------------+
| cnumber | start_date | end_date   | retainer_pct | drawings | models | presentations |
+---------+------------+------------+--------------+----------+--------+---------------+
|   11135 | 2021-07-31 | 2023-08-01 |        20.50 |       15 |      1 |             2 |
|   12345 | 2020-08-10 | 2022-08-10 |        15.25 |       20 |      2 |             3 |
|   22333 | 2021-06-15 | 2024-06-10 |        10.00 |       30 |      2 |             3 |
|   34567 | 2022-04-01 | 2022-10-01 |        25.00 |       10 |      0 |             1 |
|   44455 | 2019-05-25 | 2024-05-31 |         8.50 |       50 |      3 |             5 |
+---------+------------+------------+--------------+----------+--------+---------------+
5 rows in set (0.000 sec)
```

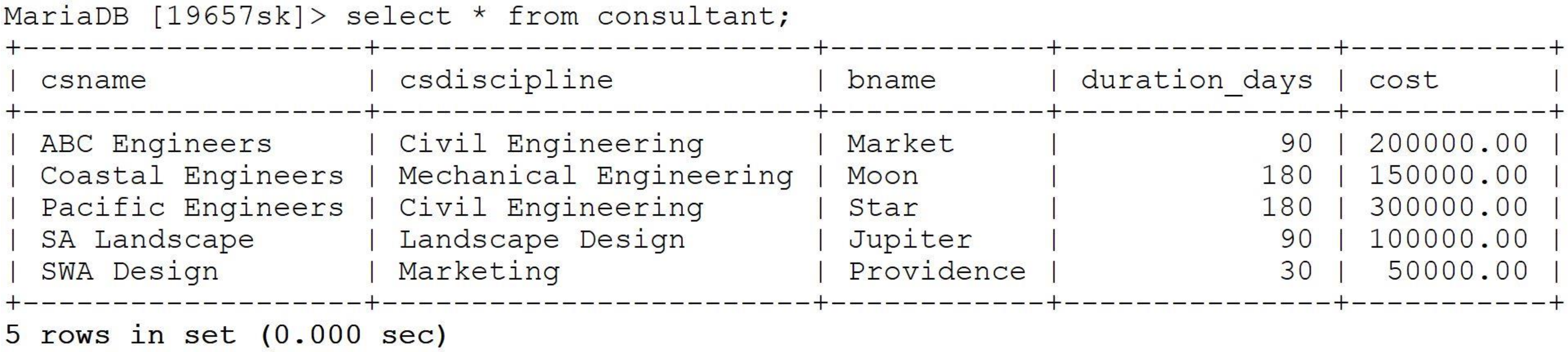


```
MariaDB [19657sk]> select * from client;
+-----------------+---------+-------+
| clname          | type    | cno   |
+-----------------+---------+-------+
| Atlantis Group  | Public  | 34567 |
| Evergreen Group | Private | 12345 |
| Hyatt Group     | Private | 11135 |
| John F. Kenneth | Public  | 22333 |
| Merchants Group | Private | 44455 |
+-----------------+---------+-------+
5 rows in set (0.000 sec)
```

SCHEMAS

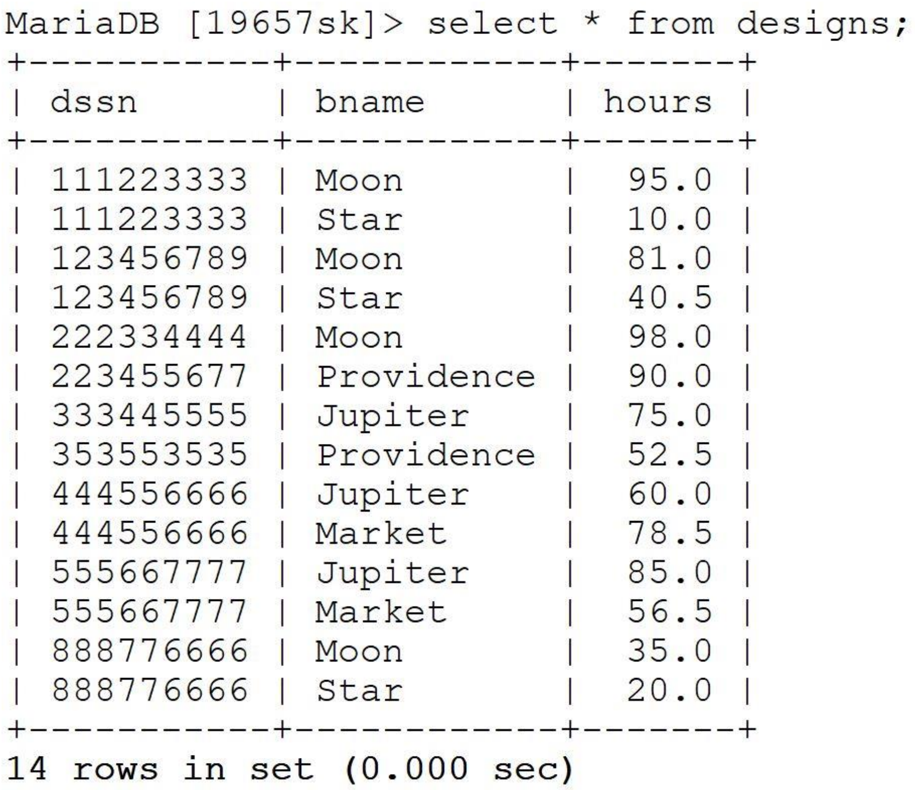


```
MariaDB [19657sk]> select * from building;
+------------+---------+---------------+---------------+---------+---------+-----------------+-------------------+-------+
| bname      | bnumber | blocation     | btype         | stories | sname   | clname          | csname            | cno   |
+------------+---------+---------------+---------------+---------+---------+-----------------+-------------------+-------+
| Jupiter    |     222 | San Francisco | Commercial    |      15 | Sam     | Merchants Group | SA Landscape      | 44455 |
| Market     |      22 | San Francisco | Residential   |       5 | Sam     | Hyatt Group     | ABC Engineers     | 11135 |
| Moon       |     100 | Chicago       | Institutional |       6 | Robert  | John F. Kenneth | Coastal Engineers | 22333 |
| Providence |     101 | Seattle       | Landscape     |       1 | Crystal | Atlantis Group  | SWA Design        | 34567 |
| Star       |     123 | Los Angeles   | Commercial    |      10 | Robert  | Evergreen Group | Pacific Engineers | 12345 |
+------------+---------+---------------+---------------+---------+---------+-----------------+-------------------+-------+
5 rows in set (0.000 sec)
```

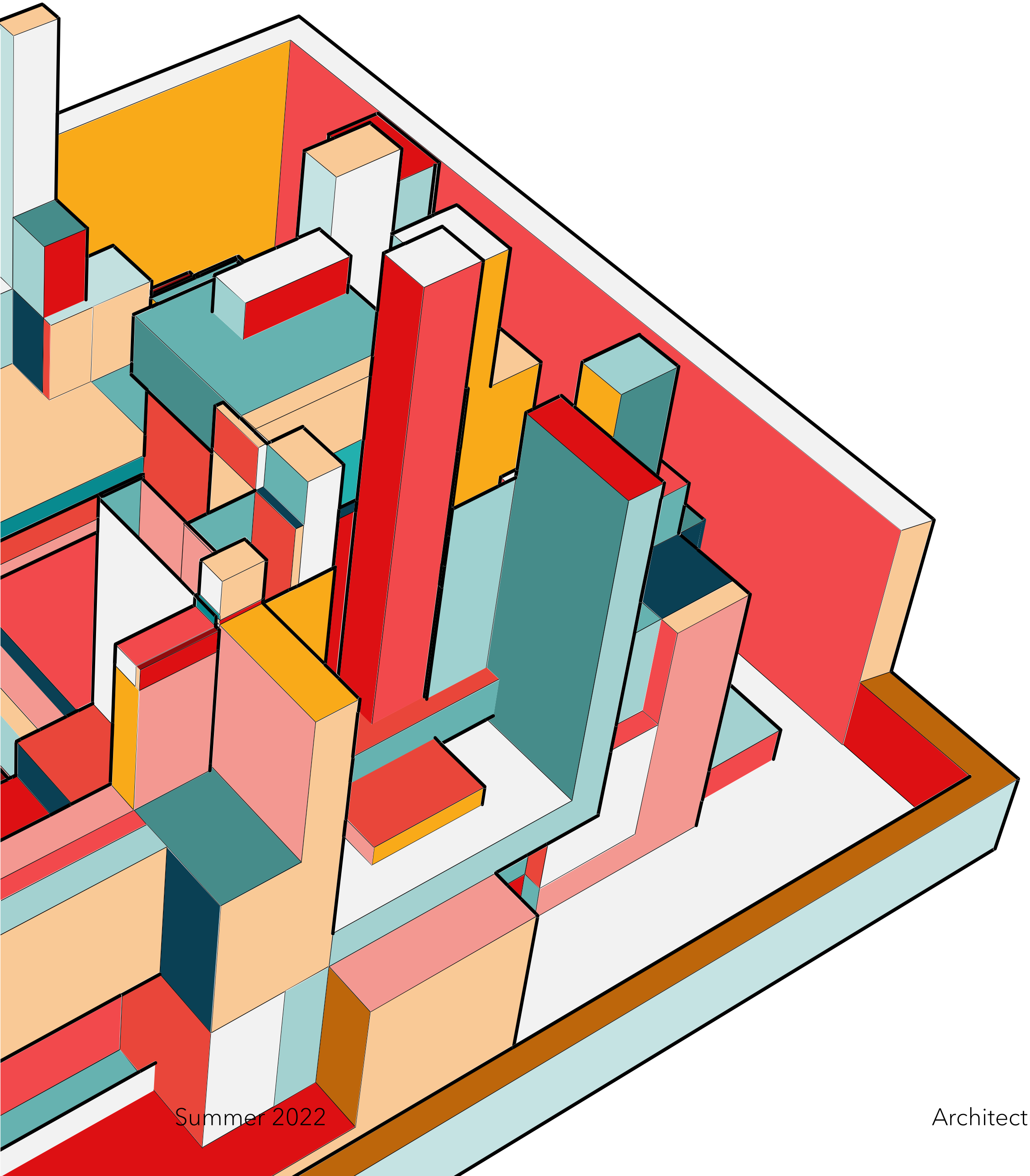


```
MariaDB [19657sk]> select * from consultant;
+-------------------+------------------------+------------+---------------+-----------+
| csname            | csdiscipline           | bname      | duration_days | cost      |
+-------------------+------------------------+------------+---------------+-----------+
| ABC Engineers     | Civil Engineering      | Market     |            90 | 200000.00 |
| Coastal Engineers | Mechanical Engineering | Moon       |           180 | 150000.00 |
| Pacific Engineers | Civil Engineering      | Star       |           180 | 300000.00 |
| SA Landscape      | Landscape Design       | Jupiter    |            90 | 100000.00 |
| SWA Design        | Marketing              | Providence |            30 |  50000.00 |
+-------------------+------------------------+------------+---------------+-----------+
5 rows in set (0.000 sec)
```

SCHEMAS



```
MariaDB [19657sk]> select * from designs;
+-----------+------------+-------+
| dssn      | bname      | hours |
+-----------+------------+-------+
| 111223333 | Moon       |  95.0 |
| 111223333 | Star       |  10.0 |
| 123456789 | Moon       |  81.0 |
| 123456789 | Star       |  40.5 |
| 222334444 | Moon       |  98.0 |
| 223455677 | Providence |  90.0 |
| 333445555 | Jupiter    |  75.0 |
| 353553535 | Providence |  52.5 |
| 444556666 | Jupiter    |  60.0 |
| 444556666 | Market     |  78.5 |
| 555667777 | Jupiter    |  85.0 |
| 555667777 | Market     |  56.5 |
| 888776666 | Moon       |  35.0 |
| 888776666 | Star       |  20.0 |
+-----------+------------+-------+
14 rows in set (0.000 sec)
```



QUERIES

A **query** is a request for data or information from a database table or combination of tables. This data may be generated as results returned by Structured Query Language (SQL).

Six clauses in the syntax of an SQL retrieval query:
Select (required) | From (required) | Where | Group By | Having | Order By

1. Create Table & Insert Values
2. Select Queries
3. Alter & Update Queries
4. Nested Queries & Sub-Queries
5. Join Queries

1. CREATE TABLE & INSERT VALUES

```
MariaDB [19657sk]> create table designer(
  -> fname varchar(15) not null,
  -> minit char,
  -> lname varchar(15) not null,
  -> ssn char(9) not null,
  -> level char,
  -> salary decimal(10,2),
  -> type varchar(25),
  -> studio_name varchar(15) not null,
  -> primary key(ssn));
```

```
MariaDB [19657sk]> insert into designer values ('Steven', 'M', 'Lee','123456789','A',40000,'Landscape','Robert');

MariaDB [19657sk]> insert into designer values ('Katherine','L','McKee','111223333','B',50000,'Architecture','Robert');

MariaDB [19657sk]> insert into designer values ('Peter','J','Yoo','222334444','C',80000,'Architecture','Robert');

MariaDB [19657sk]> insert into designer values ('Robert','F','Sanders','888776666','D',100000,'Architecture','Robert');

MariaDB [19657sk]> insert into designer values ('Susan','S','Adams','333445555','B',55000,'Urban','Sam');

MariaDB [19657sk]> insert into designer values ('Sam','E','Albert','444556666','D',100000,'Architecture','Sam');

MariaDB [19657sk]> insert into designer values ('Ming','R','Wang','555667777','C',85000,'Architecture','Sam');

MariaDB [19657sk]> insert into designer values ('Yura',’M','Minata','223455677','A',40000,'Landscape','Crystal');

MariaDB [19657sk]> insert into designer values ('Crystal','A','Bell','353553535','D',95000,'Landscape','Crystal');
```

1. CREATE TABLE & INSERT VALUES

```
MariaDB [19657sk]> create table studio(
  -> sname varchar(15) not null,
  -> sdiscipline
  -> varchar(25) not null,
  -> slocation varchar(15) not null,
  -> lead_ssn char(9) not null,
  -> primary key(sname),
  -> foreign key(lead_ssn) references designer(ssn));

MariaDB [19657sk]> insert into studio values ('Robert','Architecture','San Francisco','888776666');

MariaDB [19657sk]> insert into studio values ('Sam','Architecture','Fremont','444556666');

MariaDB [19657sk]> insert into studio values ('Crystal','Landscape','San Jose', '353553535’);
```

```
MariaDB [19657sk]> create table client(
  -> clname varchar(25) not null,
  -> type varchar(15),
  -> cno int(5) not null,
  -> primary key(clname),
  -> foreign key(cno) references contract(cnumber));

MariaDB [19657sk]> insert into client values('Evergreen Group','Private',12345);

MariaDB [19657sk]> insert into client values('John F. Kenneth','Public',22333);

MariaDB [19657sk]> insert into client values('Merchants Group','Private',44455);

MariaDB [19657sk]> insert into client values('Hyatt Group','Private',11135);

MariaDB [19657sk]> insert into client values('Atlantis Group','Public',34567);
```

1. CREATE TABLE & INSERT VALUES

```
MariaDB [19657sk]> create table contract(
  -> cnumber int(5) not null,
  -> start_date date,
  -> end_date date,
  -> retainer_pct decimal(4,2),
  -> drawings int not null,
  -> models int,
  -> presentations int,
  -> primary key(cnumber));

MariaDB [19657sk]> insert into contract values (12345,'2020-08-10','2022-08-10',15.25,20,2,3);
MariaDB [19657sk]> insert into contract values(22333,'2021-06-15','2024-06-10',10,30,2,3);
MariaDB [19657sk]> insert into contract values(44455,'2019-05-25','2024-05-31',8.5,50,3,5);
MariaDB [19657sk]> insert into contract values(11135,'2021-07-31','2023-08-01',20.5,15,1,2);
MariaDB [19657sk]> insert into contract values(34567,'2022-04-01','2022-10-01',25,10,0,1);
```

1. CREATE TABLE & INSERT VALUES

```
MariaDB [19657sk]> create table building(
  -> bname varchar(25) not null,
  -> bnumber int,
  -> blocation varchar(25) not null,
  -> btype varchar(15) not null,
  -> stories int not null,
  -> sname varchar(15) not null,
  -> clname varchar(15) not null,
  -> csname varchar(25),
  -> cno int(5) not null,
  -> primary key(bname, bnumber),
  -> foreign key(sname) references studio(sname),
  -> foreign key(clname) references client(clname),
  -> foreign key(cno)references contract(cnumber));

MariaDB [19657sk]> insert into building values ('Star',123,'Los Angeles','Commercial',10,'Robert','Evergreen Group','Pacific
Engineers',12345);

MariaDB [19657sk]> insert into building values ('Moon',100,'Chicago','Institutional',6,'Robert','John F. Kenneth','Coastal
Engineers',22333);

MariaDB [19657sk]> insert into building values ('Jupiter',222,'San Francisco','Commercial',15,'Sam','Merchants Group','SA
Landscape',44455);

MariaDB [19657sk]> insert into building values('Market',22,'San Francisco','Residential',5,'Sam','Hyatt Group','ABC
Engineers',11135);

MariaDB [19657sk]> insert into building values ('Providence',101,'Seattle','Landscape',1,'Crystal','Atlantis Group','SWA
Design',34567);
```

1. CREATE TABLE & INSERT VALUES

```
MariaDB [19657sk]> create table consultant(
  -> csname varchar(25) not null,
  -> csdiscipline varchar(25) not null,
  -> bname varchar(25) not null,
  -> duration_days int,
  -> cost decimal(10,2),
  -> primary key(csname),
  -> foreign key(bname) references building(bname));

MariaDB [19657sk]> insert into consultant values ('Pacific Engineers','Civil Engineering','Star',180,300000);

MariaDB [19657sk]> insert into consultant values ('Coastal Engineers','Mechanical Engineering','Moon',180,150000);

MariaDB [19657sk]> insert into consultant values ('ABC Engineers','Civil Engineering','Market',90,200000);

MariaDB [19657sk]> insert into consultant values ('SA Landscape','Landscape Design','Jupiter',90,100000);

MariaDB [19657sk]> insert into consultant values ('SWA Design','Marketing','Providence',30,50000);
```

1. CREATE TABLE & INSERT VALUES

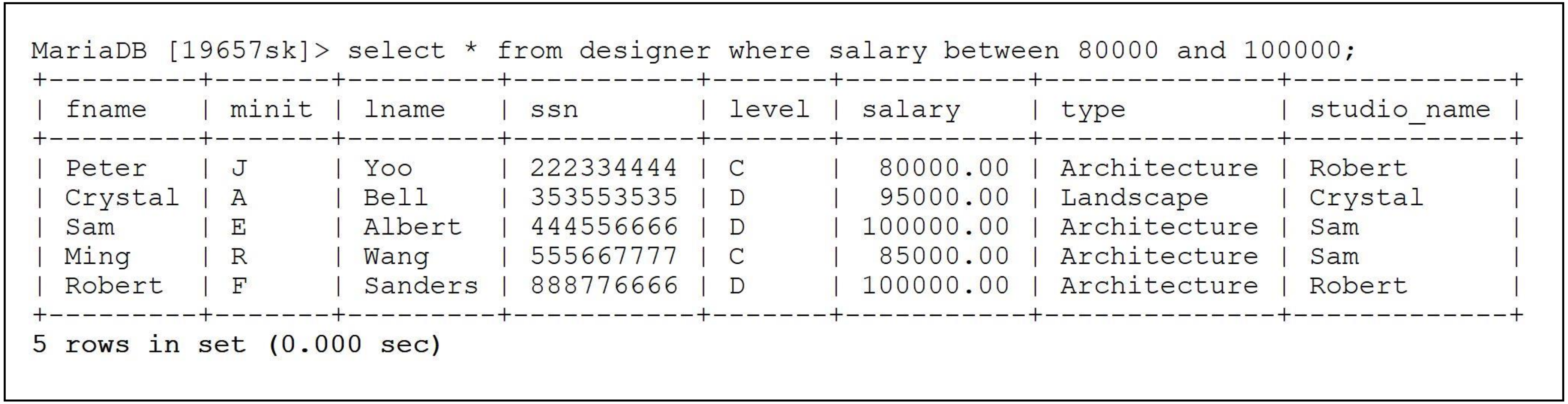
```
MariaDB [19657sk]> create table designs(
  -> dssn char(9) not null,
  -> bname varchar(25) not null,
  -> hours decimal(3,1),
  -> primary key(dssn, bname),
  -> foreign key(dssn) references designer(ssn),
  -> foreign key(bname) references building(bname));

MariaDB [19657sk]> insert into designs values ('123456789','Star',40.5);
MariaDB [19657sk]> insert into designs values('123456789','Moon',81);
MariaDB [19657sk]> insert into designs values('111223333','Star',10);
MariaDB [19657sk]> insert into designs values('111223333','Moon',95);
MariaDB [19657sk]> insert into designs values('222334444','Moon',98);
MariaDB [19657sk]> insert into designs values('888776666','Star',20);
MariaDB [19657sk]> insert into designs values('888776666','Moon',35);
MariaDB [19657sk]> insert into designs values ('333445555','Jupiter',75);
MariaDB [19657sk]> insert into designs values ('444556666','Jupiter',60);
MariaDB [19657sk]> insert into designs values ('444556666','Market',78.5);
MariaDB [19657sk]> insert into designs values ('555667777','Jupiter',85);
MariaDB [19657sk]> insert into designs values ('555667777','Market',56.5);
MariaDB [19657sk]> insert into designs values ('223455677','Providence',90);
MariaDB [19657sk]> insert into designs values ('353553535','Providence',52.5);
```

2. SELECT QUERIES

Retrieve all information of designers whose salary is between $80,000 and $100,000 (inclusive)

QUERY 1: `MariaDB [19657sk]> select * from designer where salary between 80000 and 100000;`

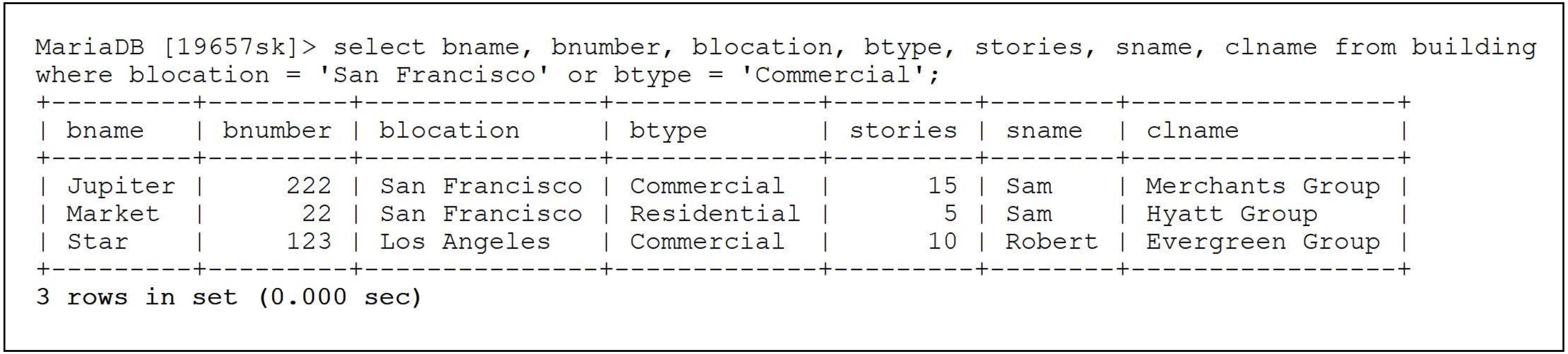


```
MariaDB [19657sk]> select * from designer where salary between 80000 and 100000;
+---------+-------+---------+-----------+-------+-----------+--------------+-------------+
| fname   | minit | lname   | ssn       | level | salary    | type         | studio_name |
+---------+-------+---------+-----------+-------+-----------+--------------+-------------+
| Peter   | J     | Yoo     | 222334444 | C     |  80000.00 | Architecture | Robert      |
| Crystal | A     | Bell    | 353553535 | D     |  95000.00 | Landscape    | Crystal     |
| Sam     | E     | Albert  | 444556666 | D     | 100000.00 | Architecture | Sam         |
| Ming    | R     | Wang    | 555667777 | C     |  85000.00 | Architecture | Sam         |
| Robert  | F     | Sanders | 888776666 | D     | 100000.00 | Architecture | Robert      |
+---------+-------+---------+-----------+-------+-----------+--------------+-------------+
5 rows in set (0.000 sec)
```

2. SELECT QUERIES

Retrieve building name, number, location, type, number of stories, studio_name, client_name where building location is San Francisco OR building type is Commercial

QUERY 2: MariaDB [19657sk]> select bname, bnumber, blocation, btype, stories, sname, clname from building where blocation = 'San Francisco' or btype = 'Commercial';

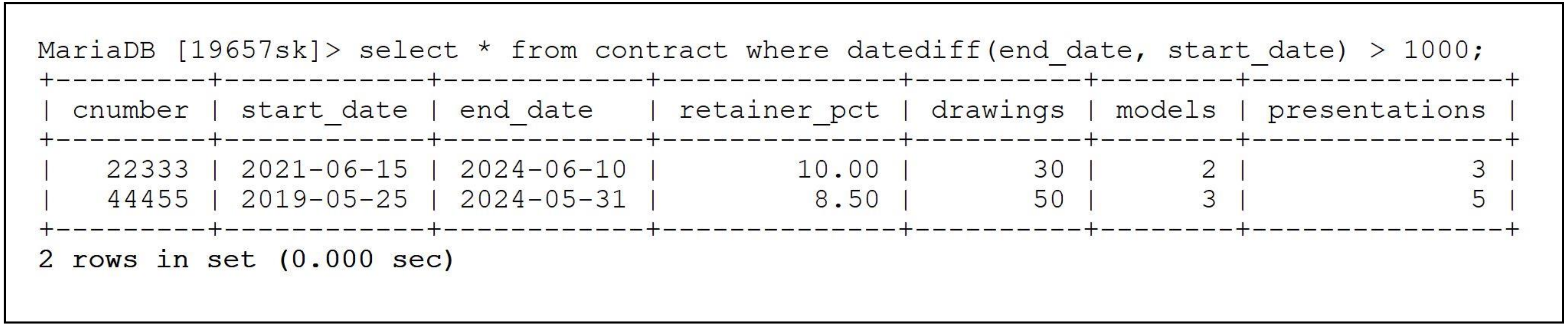


```
MariaDB [19657sk]> select bname, bnumber, blocation, btype, stories, sname, clname from building
where blocation = 'San Francisco' or btype = 'Commercial';
+---------+---------+---------------+-------------+---------+--------+-----------------+
| bname   | bnumber | blocation     | btype       | stories | sname  | clname          |
+---------+---------+---------------+-------------+---------+--------+-----------------+
| Jupiter |     222 | San Francisco | Commercial  |      15 | Sam    | Merchants Group |
| Market  |      22 | San Francisco | Residential |       5 | Sam    | Hyatt Group     |
| Star    |     123 | Los Angeles   | Commercial  |      10 | Robert | Evergreen Group |
+---------+---------+---------------+-------------+---------+--------+-----------------+
3 rows in set (0.000 sec)
```

2. SELECT QUERIES

Retrieve all contract information where duration of contract is longer than 1,000 days

QUERY 3: `MariaDB [19657sk]> select * from contract where datediff(end_date, start_date) > 1000;`

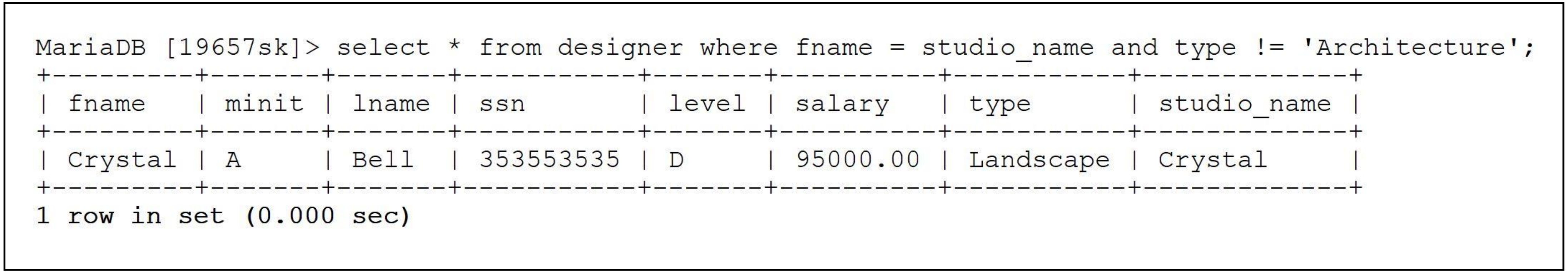


```
MariaDB [19657sk]> select * from contract where datediff(end_date, start_date) > 1000;
+---------+------------+------------+---------------+----------+--------+---------------+
| cnumber | start_date | end_date   | retainer_pct  | drawings | models | presentations |
+---------+------------+------------+---------------+----------+--------+---------------+
|   22333 | 2021-06-15 | 2024-06-10 |         10.00 |       30 |      2 |             3 |
|   44455 | 2019-05-25 | 2024-05-31 |          8.50 |       50 |      3 |             5 |
+---------+------------+------------+---------------+----------+--------+---------------+
2 rows in set (0.000 sec)
```

2. SELECT QUERIES

Retrieve information of designers whose first name is same as studio_name and type is not Architecture

QUERY 4: `MariaDB [19657sk]> select * from designer where fname = studio_name and type != 'Architecture';`



```
MariaDB [19657sk]> select * from designer where fname = studio_name and type != 'Architecture';
+---------+-------+-------+-----------+-------+----------+-----------+-------------+
| fname   | minit | lname | ssn       | level | salary   | type      | studio_name |
+---------+-------+-------+-----------+-------+----------+-----------+-------------+
| Crystal | A     | Bell  | 353553535 | D     | 95000.00 | Landscape | Crystal     |
+---------+-------+-------+-----------+-------+----------+-----------+-------------+
1 row in set (0.000 sec)
```

3. ALTER & UPDATE QUERIES

Alter the contract table by adding an additional column to store total_amount of cost and updating the cost

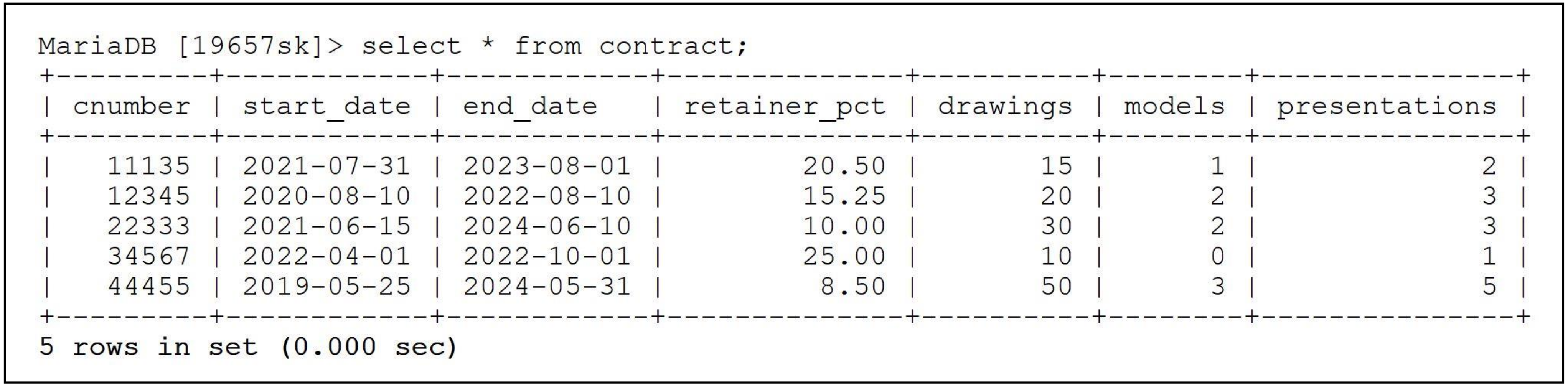
QUERY 5: `MariaDB [19657sk]> alter table contract add total_amount int not null;`

QUERY 5.1:

```
        MariaDB [19657sk]> update contract set total_amount = 650000 where cnumber = 12345;
        MariaDB [19657sk]> update contract set total_amount = 750000 where cnumber = 22333;
        MariaDB [19657sk]> update contract set total_amount = 1000000 where cnumber = 44455;
        MariaDB [19657sk]> update contract set total_amount = 200000 where cnumber = 11135;
        MariaDB [19657sk]> update contract set total_amount = 150000 where cnumber = 34567;
```

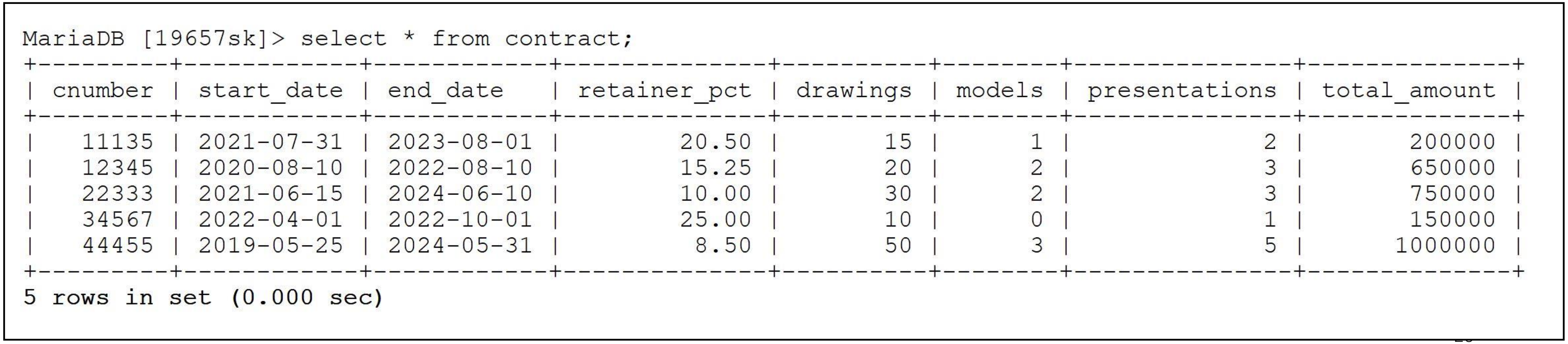
3. ALTER & UPDATE QUERIES

Before



```
MariaDB [19657sk]> select * from contract;
+---------+------------+------------+--------------+----------+--------+---------------+
| cnumber | start_date | end_date   | retainer_pct | drawings | models | presentations |
+---------+------------+------------+--------------+----------+--------+---------------+
|   11135 | 2021-07-31 | 2023-08-01 |        20.50 |       15 |      1 |             2 |
|   12345 | 2020-08-10 | 2022-08-10 |        15.25 |       20 |      2 |             3 |
|   22333 | 2021-06-15 | 2024-06-10 |        10.00 |       30 |      2 |             3 |
|   34567 | 2022-04-01 | 2022-10-01 |        25.00 |       10 |      0 |             1 |
|   44455 | 2019-05-25 | 2024-05-31 |         8.50 |       50 |      3 |             5 |
+---------+------------+------------+--------------+----------+--------+---------------+
5 rows in set (0.000 sec)
```

After

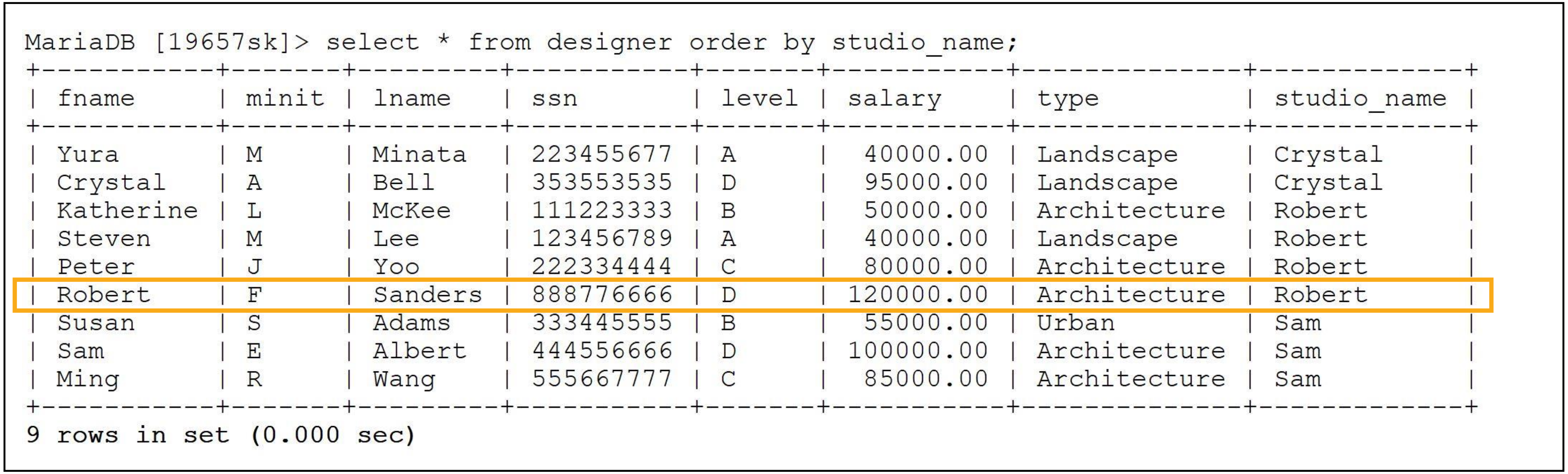


```
MariaDB [19657sk]> select * from contract;
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
| cnumber | start_date | end_date   | retainer_pct | drawings | models | presentations | total_amount |
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
|   11135 | 2021-07-31 | 2023-08-01 |        20.50 |       15 |      1 |             2 |       200000 |
|   12345 | 2020-08-10 | 2022-08-10 |        15.25 |       20 |      2 |             3 |       650000 |
|   22333 | 2021-06-15 | 2024-06-10 |        10.00 |       30 |      2 |             3 |       750000 |
|   34567 | 2022-04-01 | 2022-10-01 |        25.00 |       10 |      0 |             1 |       150000 |
|   44455 | 2019-05-25 | 2024-05-31 |         8.50 |       50 |      3 |             5 |      1000000 |
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
5 rows in set (0.000 sec)
```

3. ALTER & UPDATE QUERIES

Update the salary of Robert by increasing it to120%

QUERY 6: MariaDB [19657sk]> update designer set salary = salary * 1.2 where fname = 'Robert';

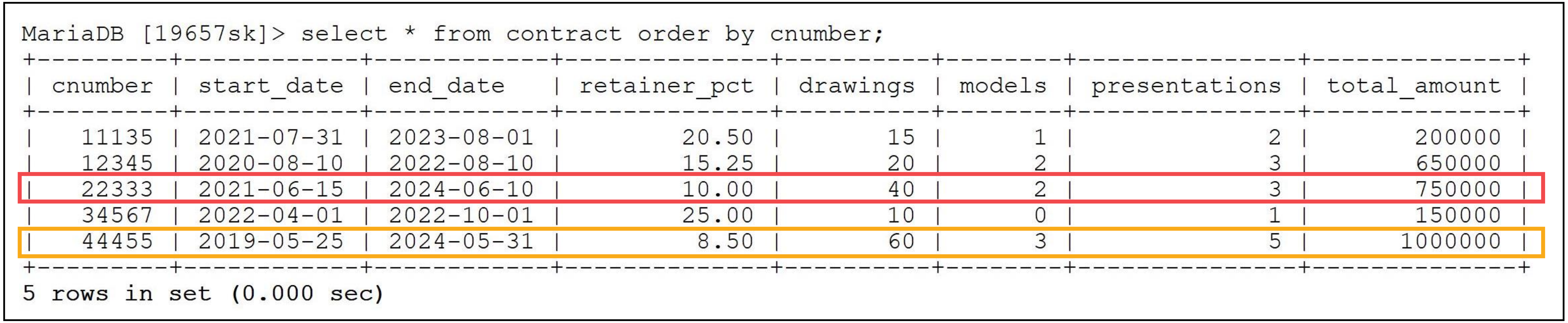


```
MariaDB [19657sk]> select * from designer order by studio_name;
+-----------+-------+----------+-----------+-------+-----------+--------------+-------------+
| fname     | minit | lname    | ssn       | level | salary    | type         | studio_name |
+-----------+-------+----------+-----------+-------+-----------+--------------+-------------+
| Yura      | M     | Minata   | 223455677 | A     |  40000.00 | Landscape    | Crystal     |
| Crystal   | A     | Bell     | 353553535 | D     |  95000.00 | Landscape    | Crystal     |
| Katherine | L     | McKee    | 111223333 | B     |  50000.00 | Architecture | Robert      |
| Steven    | M     | Lee      | 123456789 | A     |  40000.00 | Landscape    | Robert      |
| Peter     | J     | Yoo      | 222334444 | C     |  80000.00 | Architecture | Robert      |
| Robert    | F     | Sanders  | 888776666 | D     | 120000.00 | Architecture | Robert      |
| Susan     | S     | Adams    | 333445555 | B     |  55000.00 | Urban        | Sam         |
| Sam       | E     | Albert   | 444556666 | D     | 100000.00 | Architecture | Sam         |
| Ming      | R     | Wang     | 555667777 | C     |  85000.00 | Architecture | Sam         |
+-----------+-------+----------+-----------+-------+-----------+--------------+-------------+
9 rows in set (0.000 sec)
```

3. ALTER & UPDATE QUERIES

Update the number of required drawings by 10 more for contracts with total contractual amount more than $700,000

QUERY 7: `MariaDB [19657sk]> update contract set drawings = drawings + 10 where total_amount > 700000 order by cnumber;`

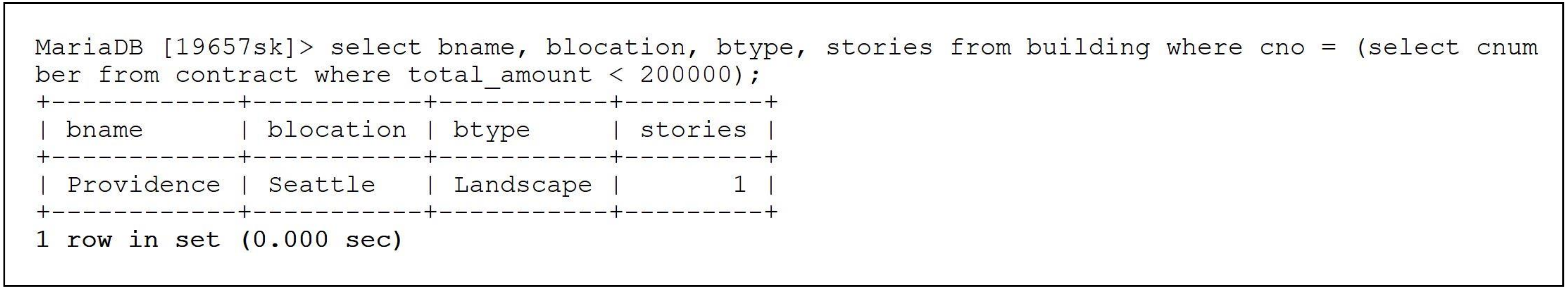


```
MariaDB [19657sk]> select * from contract order by cnumber;
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
| cnumber | start_date | end_date   | retainer_pct | drawings | models | presentations | total_amount |
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
|   11135 | 2021-07-31 | 2023-08-01 |        20.50 |       15 |      1 |             2 |       200000 |
|   12345 | 2020-08-10 | 2022-08-10 |        15.25 |       20 |      2 |             3 |       650000 |
|   22333 | 2021-06-15 | 2024-06-10 |        10.00 |       40 |      2 |             3 |       750000 |
|   34567 | 2022-04-01 | 2022-10-01 |        25.00 |       10 |      0 |             1 |       150000 |
|   44455 | 2019-05-25 | 2024-05-31 |         8.50 |       60 |      3 |             5 |      1000000 |
+---------+------------+------------+--------------+----------+--------+---------------+--------------+
5 rows in set (0.000 sec)
```

4. NESTED QUERIES & SUB-QUERIES

Retrieve building name, location, type, and number of stories from buildings with contractual amount less than $200,000

QUERY 8: MariaDB [19657sk]> select bname, blocation, btype, stories from building where cno = (select cnumber from contract where total_amount < 200000);

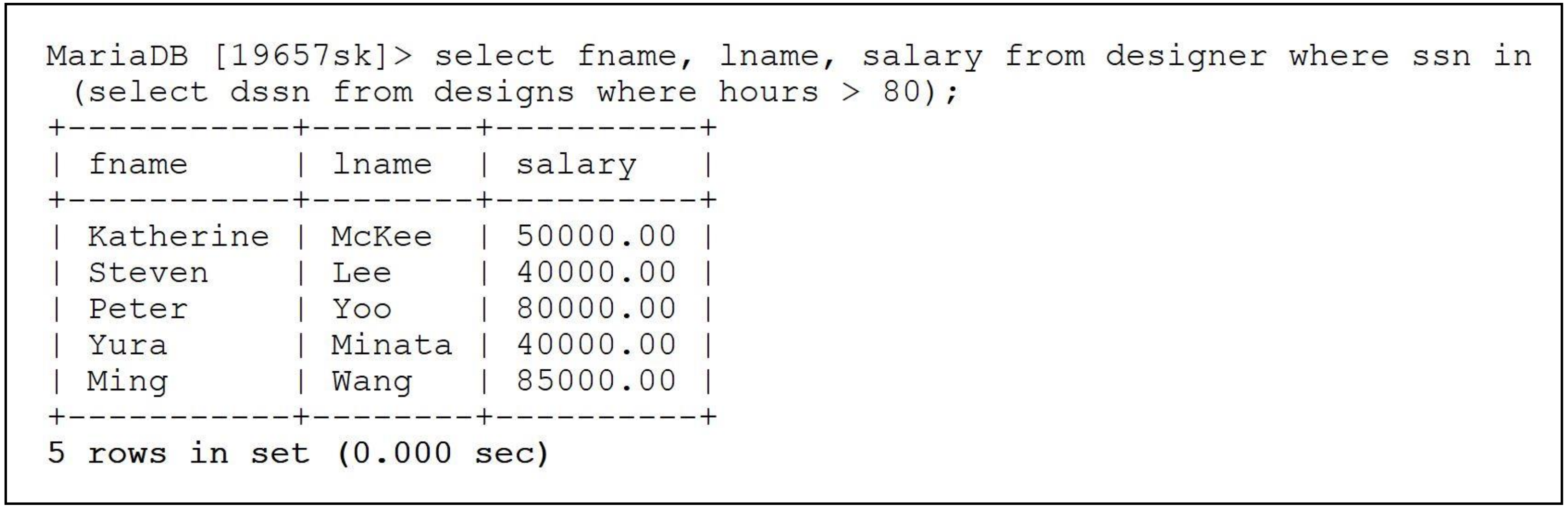


```
MariaDB [19657sk]> select bname, blocation, btype, stories from building where cno = (select cnum
ber from contract where total_amount < 200000);
+------------+-----------+-----------+---------+
| bname      | blocation | btype     | stories |
+------------+-----------+-----------+---------+
| Providence | Seattle   | Landscape |       1 |
+------------+-----------+-----------+---------+
1 row in set (0.000 sec)
```

4. NESTED QUERIES & SUB-QUERIES

Retrieve first and last name and salary of designers who worked on a building for more than 80 hours

QUERY 9: `MariaDB [19657sk]> select fname, lname salary from designer where ssn in (select dssn from designs where hours > 80);`

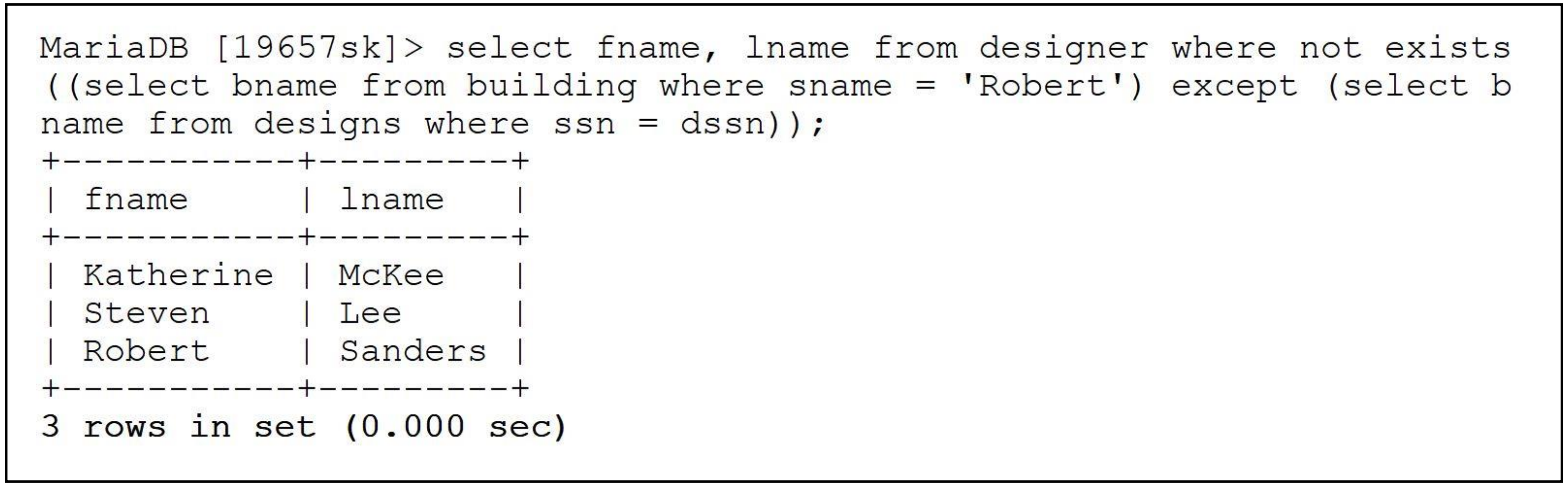


```
MariaDB [19657sk]> select fname, lname, salary from designer where ssn in
 (select dssn from designs where hours > 80);
+-----------+--------+----------+
| fname     | lname  | salary   |
+-----------+--------+----------+
| Katherine | McKee  | 50000.00 |
| Steven    | Lee    | 40000.00 |
| Peter     | Yoo    | 80000.00 |
| Yura      | Minata | 40000.00 |
| Ming      | Wang   | 85000.00 |
+-----------+--------+----------+
5 rows in set (0.000 sec)
```

4. NESTED QUERIES & SUB-QUERIES

Retrieve first and last name of designers for whom there does not exist a building designed by Robert's studio that they do not work on -> designers who work on all projects controlled by Robert's studio

QUERY 10: `MariaDB [19657sk]> select fname, lname from designer where not exists ((select bname from building where sname = ‘Robert’) except (select bname from designs where ssn = dssn));`

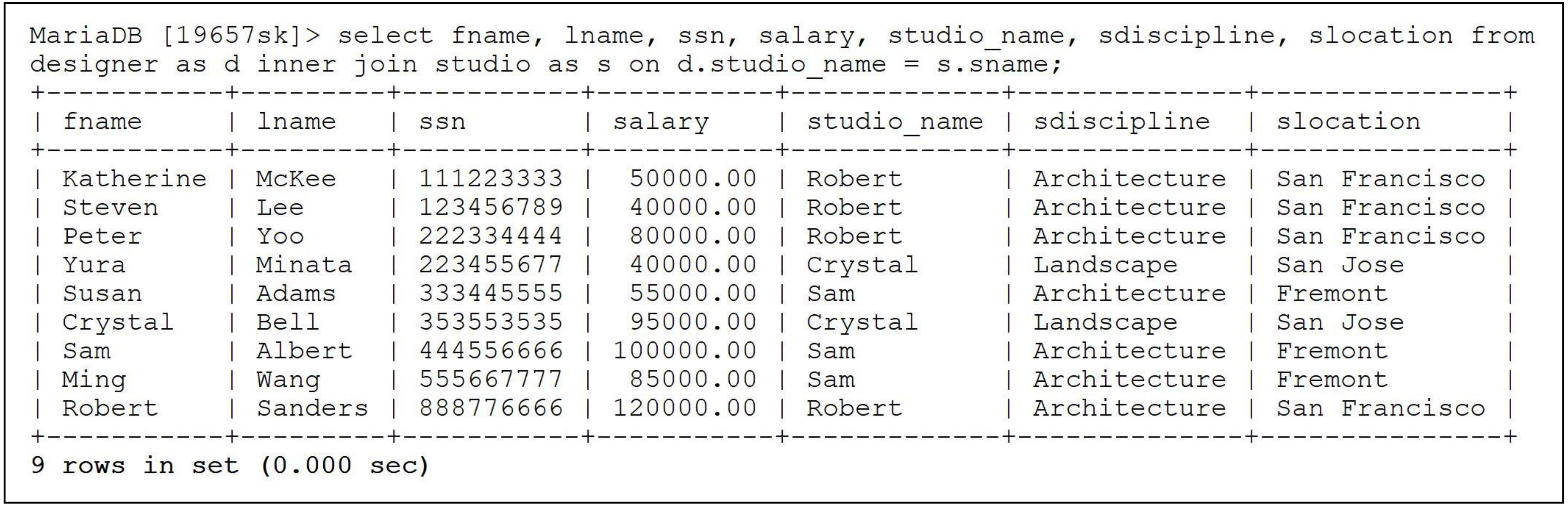


```
MariaDB [19657sk]> select fname, lname from designer where not exists
((select bname from building where sname = 'Robert') except (select b
name from designs where ssn = dssn));
+-----------+----------+
| fname     | lname    |
+-----------+----------+
| Katherine | McKee    |
| Steven    | Lee      |
| Robert    | Sanders  |
+-----------+----------+
3 rows in set (0.000 sec)
```

5. JOIN QUERIES – TWO WAY

Retrieve information from designer table and studio table using inner join

QUERY 11: `MariaDB [19657sk]> select fname, lname, ssn, salary, studio_name, sdiscipline, slocation from designer as d inner join studio as s on d.studio_name = s.sname;`

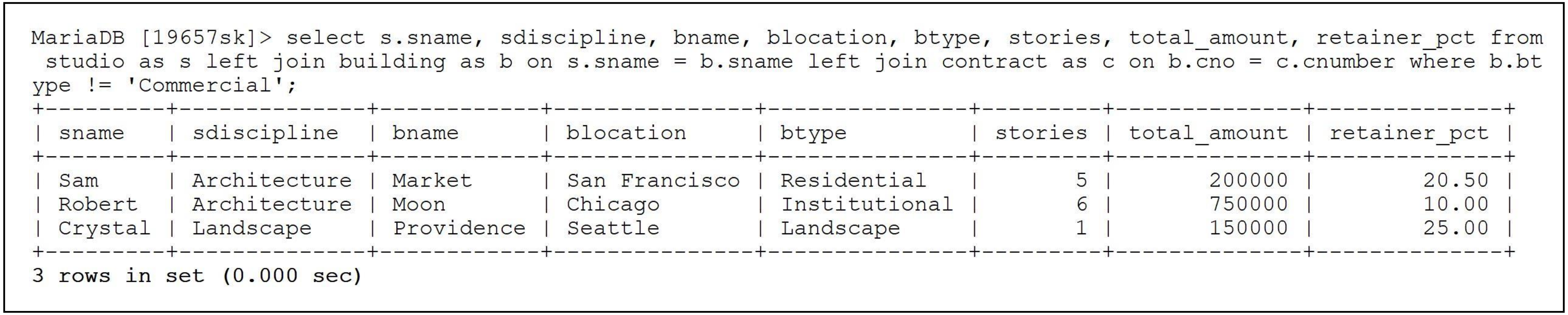


```
MariaDB [19657sk]> select fname, lname, ssn, salary, studio_name, sdiscipline, slocation from
designer as d inner join studio as s on d.studio_name = s.sname;
+-----------+---------+-----------+-----------+-------------+--------------+---------------+
| fname     | lname   | ssn       | salary    | studio_name | sdiscipline  | slocation     |
+-----------+---------+-----------+-----------+-------------+--------------+---------------+
| Katherine | McKee   | 111223333 |  50000.00 | Robert      | Architecture | San Francisco |
| Steven    | Lee     | 123456789 |  40000.00 | Robert      | Architecture | San Francisco |
| Peter     | Yoo     | 222334444 |  80000.00 | Robert      | Architecture | San Francisco |
| Yura      | Minata  | 223455677 |  40000.00 | Crystal     | Landscape    | San Jose      |
| Susan     | Adams   | 333445555 |  55000.00 | Sam         | Architecture | Fremont       |
| Crystal   | Bell    | 353553535 |  95000.00 | Crystal     | Landscape    | San Jose      |
| Sam       | Albert  | 444556666 | 100000.00 | Sam         | Architecture | Fremont       |
| Ming      | Wang    | 555667777 |  85000.00 | Sam         | Architecture | Fremont       |
| Robert    | Sanders | 888776666 | 120000.00 | Robert      | Architecture | San Francisco |
+-----------+---------+-----------+-----------+-------------+--------------+---------------+
9 rows in set (0.000 sec)
```

5. JOIN QUERIES – THREE WAY

Retrieve information from studio table, building table, contract table using left outer join where building type is NOT commercial

QUERY 12: MariaDB [19657sk]> select s.sname, sdiscipline, bname, blocation, btype, stories, total_amount, retainer_pct from studio as s left join building as b on s.sname = b.sname left join contract as c on b.cno = c.cnumber where b.btype != ‘Commercial’;

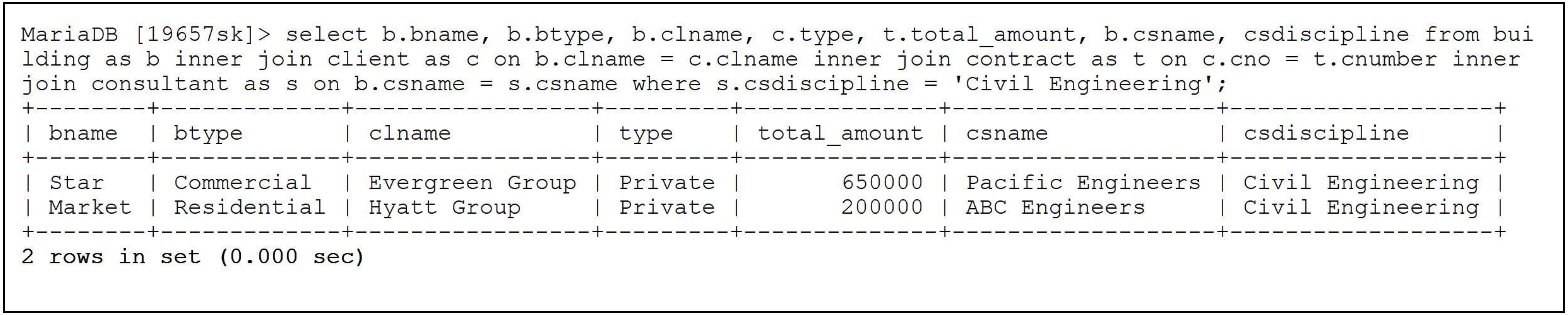


```
MariaDB [19657sk]> select s.sname, sdiscipline, bname, blocation, btype, stories, total_amount, retainer_pct from
 studio as s left join building as b on s.sname = b.sname left join contract as c on b.cno = c.cnumber where b.bt
ype != 'Commercial';
+---------+-------------+------------+---------------+---------------+---------+--------------+--------------+
| sname   | sdiscipline | bname      | blocation     | btype         | stories | total_amount | retainer_pct |
+---------+-------------+------------+---------------+---------------+---------+--------------+--------------+
| Sam     | Architecture | Market    | San Francisco | Residential   |       5 |       200000 |        20.50 |
| Robert  | Architecture | Moon      | Chicago       | Institutional |       6 |       750000 |        10.00 |
| Crystal | Landscape   | Providence | Seattle       | Landscape     |       1 |       150000 |        25.00 |
+---------+-------------+------------+---------------+---------------+---------+--------------+--------------+
3 rows in set (0.000 sec)
```

5. JOIN QUERIES – FOUR WAY

Retrieve information from building table, client table, contract table, and consultant table using inner join to find out buildings where civil engineering consultants are used.

QUERY 13: MariaDB [19657sk]> select b.bname, b.btype, b.clname, c.type, t.total_amount, b.csname, csdiscipline from building as b inner join client as c on b.clname = c.clname inner join contract as t on c.cno = t.cnumber inner join consultant as s on b.csname = s.csname where s.csdiscipline = ‘Civil Engineering’;

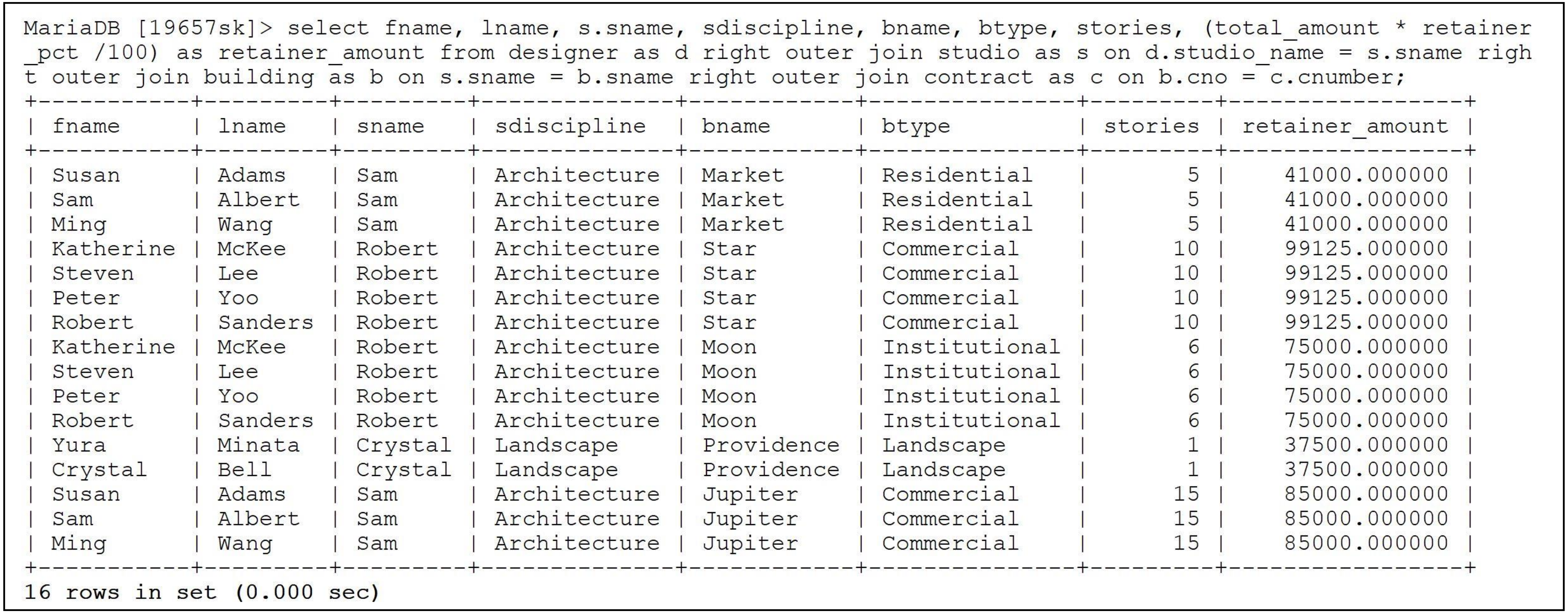


```
MariaDB [19657sk]> select b.bname, b.btype, b.clname, c.type, t.total_amount, b.csname, csdiscipline from bui
lding as b inner join client as c on b.clname = c.clname inner join contract as t on c.cno = t.cnumber inner
join consultant as s on b.csname = s.csname where s.csdiscipline = 'Civil Engineering';
+--------+-------------+-----------------+---------+--------------+-------------------+-------------------+
| bname  | btype       | clname          | type    | total_amount | csname            | csdiscipline      |
+--------+-------------+-----------------+---------+--------------+-------------------+-------------------+
| Star   | Commercial  | Evergreen Group | Private |       650000 | Pacific Engineers | Civil Engineering |
| Market | Residential | Hyatt Group     | Private |       200000 | ABC Engineers     | Civil Engineering |
+--------+-------------+-----------------+---------+--------------+-------------------+-------------------+
2 rows in set (0.000 sec)
```

5. JOIN QUERIES – FOUR WAY

Retrieve information from designer table, studio table, building table, and contract table using right outer join and calculate the retainer_amount by multiplying retainer percentage with total contractual amount.

QUERY 14:



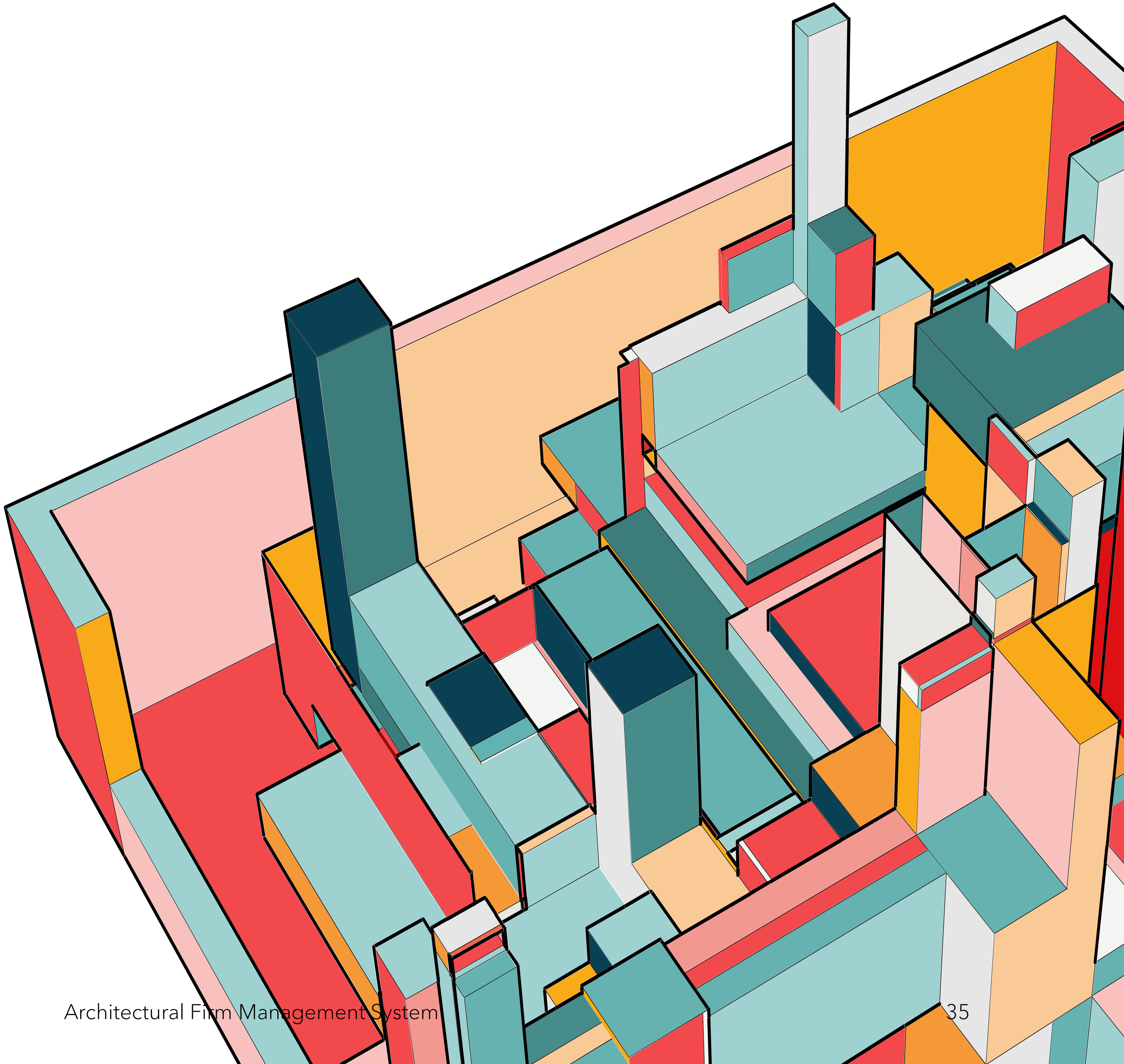
```
MariaDB [19657sk]> select fname, lname, s.sname, sdiscipline, bname, btype, stories, (total_amount * retainer
_pct /100) as retainer_amount from designer as d right outer join studio as s on d.studio_name = s.sname righ
t outer join building as b on s.sname = b.sname right outer join contract as c on b.cno = c.cnumber;
+-----------+---------+---------+--------------+------------+---------------+---------+-----------------+
| fname     | lname   | sname   | sdiscipline  | bname      | btype         | stories | retainer_amount |
+-----------+---------+---------+--------------+------------+---------------+---------+-----------------+
| Susan     | Adams   | Sam     | Architecture | Market     | Residential   |       5 |    41000.000000 |
| Sam       | Albert  | Sam     | Architecture | Market     | Residential   |       5 |    41000.000000 |
| Ming      | Wang    | Sam     | Architecture | Market     | Residential   |       5 |    41000.000000 |
| Katherine | McKee   | Robert  | Architecture | Star       | Commercial    |      10 |    99125.000000 |
| Steven    | Lee     | Robert  | Architecture | Star       | Commercial    |      10 |    99125.000000 |
| Peter     | Yoo     | Robert  | Architecture | Star       | Commercial    |      10 |    99125.000000 |
| Robert    | Sanders | Robert  | Architecture | Star       | Commercial    |      10 |    99125.000000 |
| Katherine | McKee   | Robert  | Architecture | Moon       | Institutional |       6 |    75000.000000 |
| Steven    | Lee     | Robert  | Architecture | Moon       | Institutional |       6 |    75000.000000 |
| Peter     | Yoo     | Robert  | Architecture | Moon       | Institutional |       6 |    75000.000000 |
| Robert    | Sanders | Robert  | Architecture | Moon       | Institutional |       6 |    75000.000000 |
| Yura      | Minata  | Crystal | Landscape    | Providence | Landscape     |       1 |    37500.000000 |
| Crystal   | Bell    | Crystal | Landscape    | Providence | Landscape     |       1 |    37500.000000 |
| Susan     | Adams   | Sam     | Architecture | Jupiter    | Commercial    |      15 |    85000.000000 |
| Sam       | Albert  | Sam     | Architecture | Jupiter    | Commercial    |      15 |    85000.000000 |
| Ming      | Wang    | Sam     | Architecture | Jupiter    | Commercial    |      15 |    85000.000000 |
+-----------+---------+---------+--------------+------------+---------------+---------+-----------------+
16 rows in set (0.000 sec)
```

MATHEMATICAL NOTATIONS

Two formal languages for the relational model are the *relational algebra and the relational calculus*, which both were developed before the SQL language.

The basic set of operations for the formal relational model is the **relational algebra**.

The **relational calculus** provides a higher-level declarative language for specifying relational queries.



BASIC QUERIES

```
select * from designer where salary between 80000 and 100000;
```

$\sigma_{\text{salary >= 80000 AND salary <= 100000}}\text{(DESIGNER)}$

```
select bname, bnumber, blocation, btype, stories, sname, clname from building where blocation = 'San Francisco'
or btype = 'Commercial';
```

$\pi_{\text{bname, bnumer, blocation, btype, stories, sname, clname}}(\sigma_{\text{blocation = 'San Francisco' OR btype = 'Commercial'}}\text{(BUILDING)})$

```
select * from contract where datediff(end_date, start_date) > 1000;
```

$\sigma_{\mathcal{F}\text{datediff(end\_date, start\_date) >1000}}\text{(CONTRACT)}$

```
select * from designer where fname = studio_name and type != 'Architecture';
```

$\sigma_{\text{fname = studio\_name AND type != 'Architecture}}\text{(DESIGNER)}$

NESTED QUERIES

```
select bname, blocation, btype, stories from building where cno = (select cnumber from contract where
total_amount < 200000);
```

$\text{CNO} \leftarrow \pi_{\text{cnumber}}(\sigma_{\text{total\_amount} < 200000}(\text{CONTRACT}))$

$\text{RESULT} \leftarrow \pi_{\text{bname, blocation, btype, stories}}(\sigma_{\text{cno} = \text{CNO}}(\text{BUILDING}))$

```
select fname, lname, salary from designer where ssn in (select dssn from designs where hours > 80);
```

$\text{DESIGNERS} \leftarrow \pi_{\text{dssn}}(\sigma_{\text{hours} > 80}(\text{DESIGNS}))$

$\text{RESULT} \leftarrow \pi_{\text{fname, lname, salary}}(\sigma_{\text{ssn} = \text{DESIGNERS}}(\text{DESIGNER}))$

```
select fname, lname from designer where not exists ((select bname from building where sname = ‘Robert’) except
(select bname from designs where ssn = dssn));
```

$\text{DESIGNERS} \leftarrow \pi_{\text{bname}}(\sigma_{\text{ssn} = \text{dssn}}(\text{DESIGNS}))$

$\text{BNAME} \leftarrow \pi_{\text{bname}}(\sigma_{\text{sname} = \text{‘Robert’}}(\text{BUILDING}))$

$\text{RESULT} \leftarrow \pi_{\text{fname, lname}}(\text{DESIGNER}) \triangleright (\text{BNAME} - \text{DESIGNERS})$

JOIN QUERIES

```
select fname, lname, ssn, salary, studio_name, sdiscipline, slocation from designer as d inner join studio as s
on d.studio_name = s.sname;
```

$\pi_{\text{fname lname, ssn, salary, studio\_name, sdiscipline, slocation}}(\rho_{d}\ \text{DESIGNER} \bowtie_{\text{d.studio\_name = s.sname}} \rho_{s}\ \text{STUDIO})$

```
select s.sname, sdiscipline, bname, blocation, btype, stories, total_amount, retainer_pct from studio as s left
join building as b on s.sname = b.sname left join contract as c on b.cno = c.cnumber where b.btype !=
‘Commercial’;
```

$\pi_{\text{s.sname, sdiscipline, bname, blocation, btype, stories, total\_amount, retainer\_pct}}(\sigma_{\text{b.btype != ‘Commercial’}}(\rho_{s}\ \text{STUDIO} ⟕_{\text{s.sname = b.sname}} \rho_{b}\ \text{BUILDING} ⟕_{\text{b.cno = c.cnumber}} \rho_{c}\ \text{CONTRACT})$

JOIN QUERIES

```
select b.bname, b.btype, b.clname, c.type, t.total_amount, b.csname, csdiscipline from building as b inner join
client as c on b.clname = c.clname inner join contract as t on c.cno = t.cnumber inner join consultant as s on
b.csname = s.csname where s.csdiscipline = ‘Civil Engineering’;
```

$\pi_{b.bname,\ b.btype,\ b.clname,\ c.type,\ t.total\_amount,\ b.csname,\ csdiscipline}(\sigma_{s.csdiscipline\ =\ \text{‘Civil Engineering’}}(\rho_b\ \text{BUILDING} \bowtie_{b.clname\ =\ c.clname} \rho_c\ \text{CLIENT} \bowtie_{c.cno\ =\ t.cnumber} \rho_t\ \text{CONTRACT} \bowtie_{b.csname\ =\ s.csname} \rho_s\ \text{CONSULTANT})$

```
select fname, lname, s.sname, sdiscipline, bname, btype, stories, (total_amount * retainer_pct / 100) as
retainer_amount from designer as d right outer join studio as s on d.studio_name = s.sname right outer join
building as b on s.sname = b.sname right outer join contract as c on b.cno = c.cnumber;
```

$\pi_{fname\ lname,\ s.sname,\ sdiscipline,\ bname,\ btype,\ stories,\ \rho_{retainer\_amount}\ (TOTAL\_AMOUNT\ *\ RETAINER\_PCT\ /\ 100)}\ (\rho_d\ \text{DESIGNER} ⟖_{d.studio\_name\ =\ s.sname} \rho_s\ \text{STUDIO} ⟖_{s.sname\ =\ b.sname} \rho_b\ \text{BUILDING} ⟖_{b.cno\ =\ c.cnumber} \rho_c\ \text{CONTRACT})$

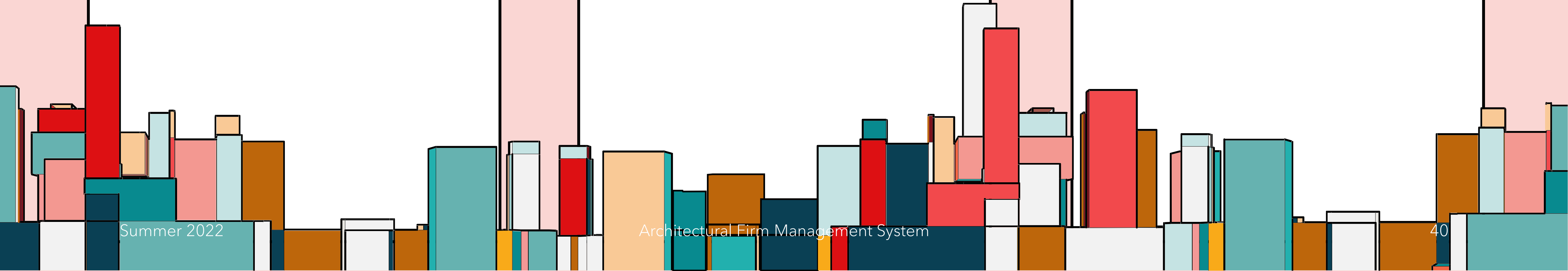
CONCLUSION

How the management system can be universally applicable

The architecture firm management system allows easy management of people, projects, and outside entities.

Contracts are essential to a design firm as they are the link to designers, clients, and consultants.

The architecture firm management system can easily apply to other design studios and firms.



THANK YOU

CS457 Signature Assignment

Ke (Kathy) She | Student ID - 19657