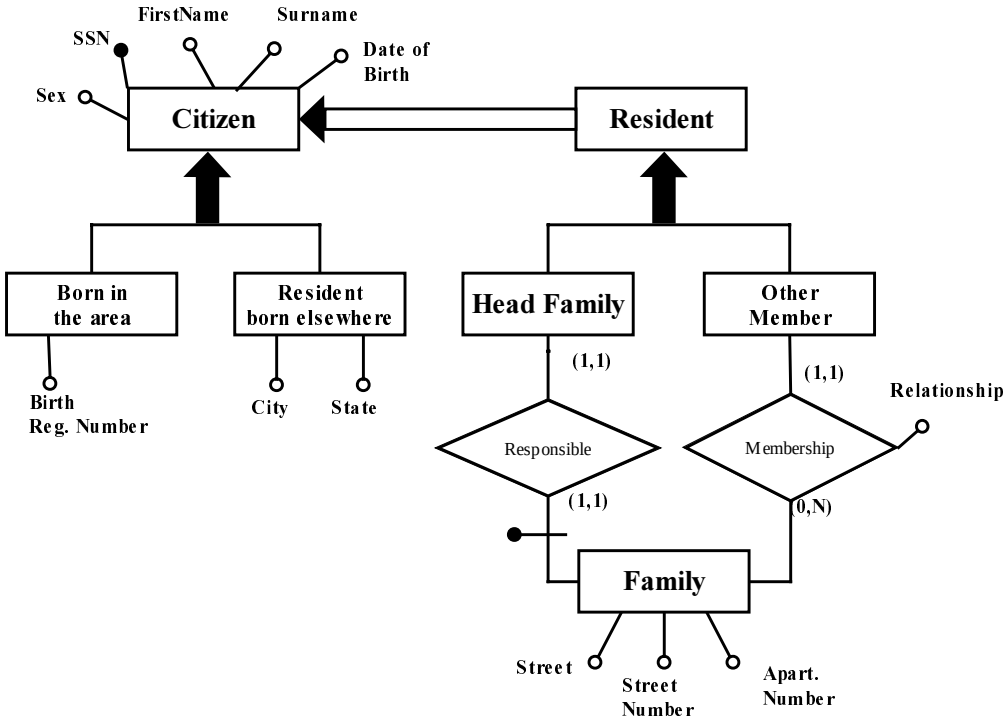
Chapter 7

Exercise 7.1

Consider the E-R schema in Exercise 6.4. make hypotheses on the volume of data and the operations possible on this data and, based on these hypotheses, carry out the necessary restructuring of the schema.
Then carry out the translation to the relational model.

Solution:

This is the schema produced in Exercise 6.4:



The following tables contains hypotheses on volumes and operations:

Volumes:

Concept	Type	Volume
Citizen	E	1100000
Born in the area	E	1000000
Resident born elsewhere	E	100000
Resident	E	1000000
Head Family	E	250000
Other Member	E	750000
Family	E	250000
Responsible	R	250000
Membership	R	750000

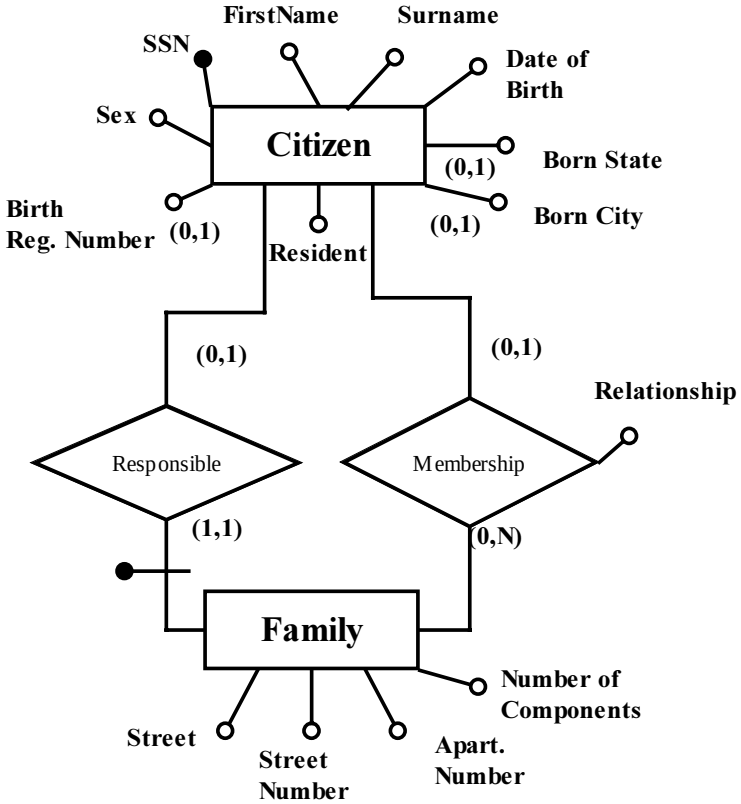
Operations

Operation	Description	Frequency	Type
1	Add a new citizen born in the area	100 per day	I
2	Add a new citizen resident in the area but born elsewhere	20 per day	I
3	Add a new family	20 per day	I
4	Delete a citizen	100 per day	I
5	Delete a family	5 per day	I
6	Show the number of the resident citizens	1 per day	B
7	Show the number of resident men and women	1 per day	B

It could be useful to add a redundant attribute "Number of Components" to the entity FAMILY.
Without this attribute, operations 6 needs 1000000 read accesses to the entity Resident each day.
With the redundant attribute, the operation 6 needs only 250000 read accesses to FAMILY.
However, the presence of this attribute changes the cost of operations 1,2 and 4; in fact these 3 operations need now, more than the indispensable accesses, 1 read access to HEAD FAMILY, (or to OTHER MEMBER), 1 read access to RESPONSIBLE (or to MEMBERSHIP), 1 read access and 1 write access to FAMILY (to update the attribute "Number of Components".
Supposing the write accesses having the cost of 2 read accesses, the total cost is (1+1+1+2)*90 + (1+1+1+2)*20 + (1+1+1+2)*100= 1050.
The frequency for operation 1 is 90 because not all the citizens born in the area are resident, but only the 90%.

So the advantage of the redundant attribute is 750000-1050=748950 accesses per day.

Restructuring:



Translation:

CITIZEN (SSN, FirstName, Surname, DateOfBirth, BornState, BornCity, BornRegNumber, Resident),

FAMILY (Head, Street, StreetNumber, ApartNumber, Components) with referential constraints between **Head** and relation CITIZEN,

MEMBERSHIP (Citizen, Family, Relationship) with referential constraints between **Citizen** and relation CITIZEN and between **Family** and relation FAMILY.

Exercise 7.2

Translate the E-R schema on the personnel of a company (shown again for convenience in Figure 7.35) into a schema of the relational model.

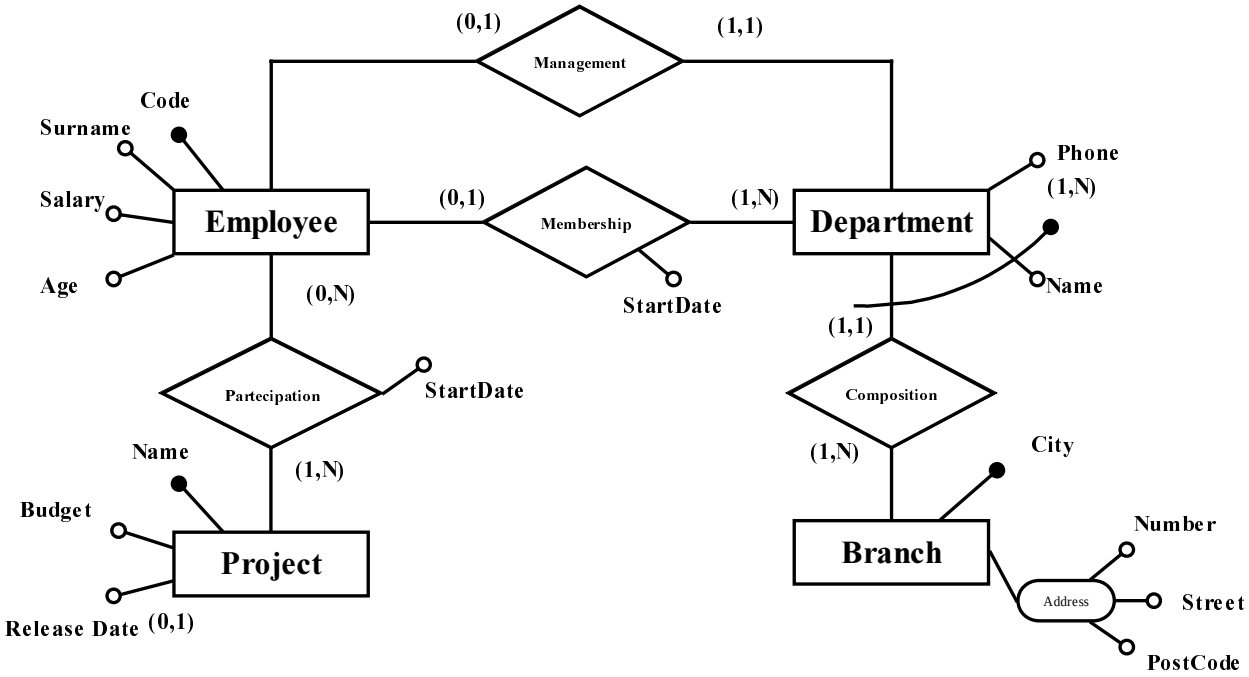


Figure 7.35

Solution:

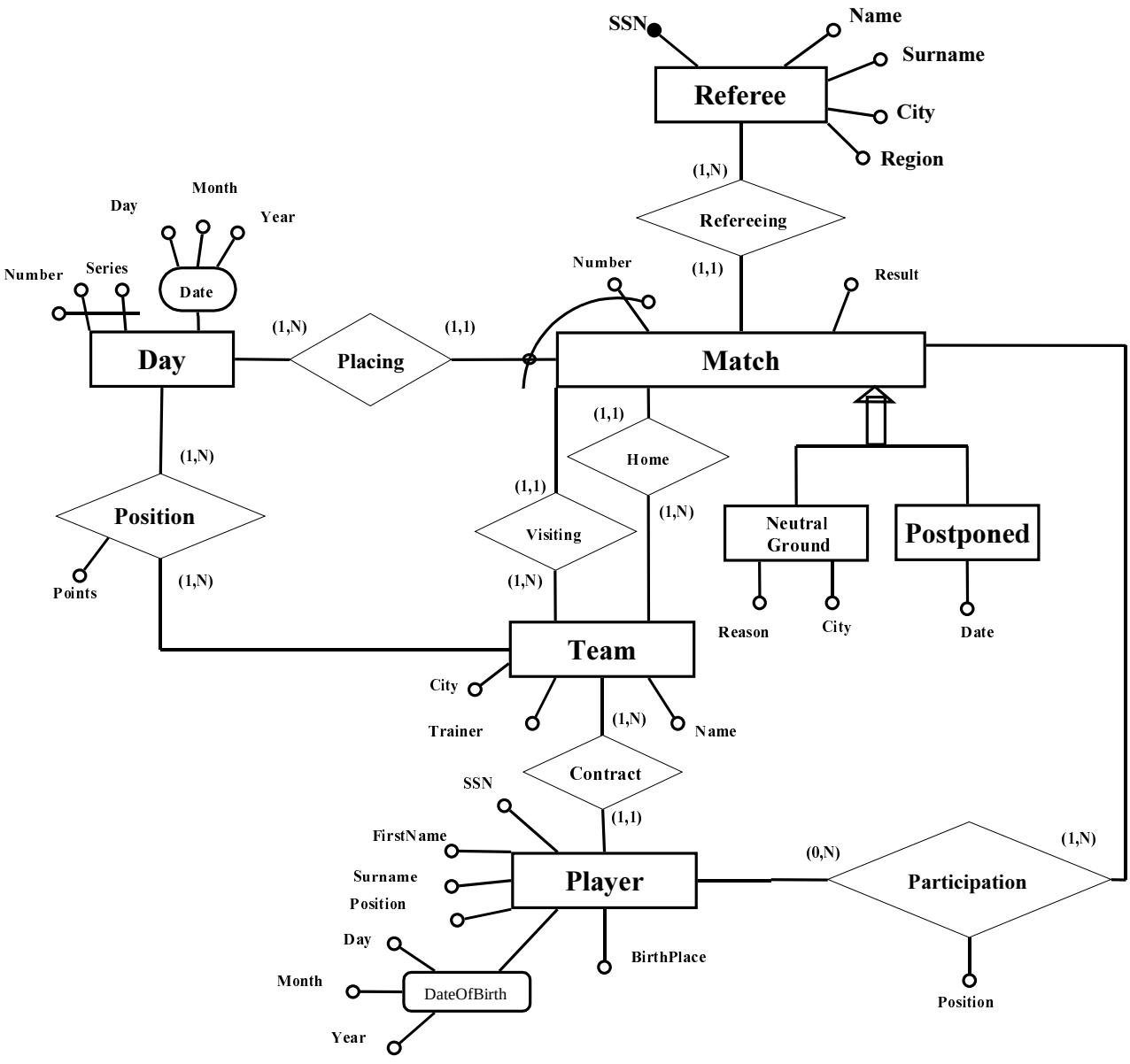
- EMPLOYEE (Code, Surname, Salary, Age, Department, Branch, StartDate), with referential constraints between **Department** and relation DEPARTMENT, between **Branch** and relation BRANCH.
- DEPARTMENT (Name, Branch,), with referential constraints between **branch** and relation BRANCH.
- PHONE (Department, Number), with referential constraint between **Department** and relation DEPARTMENT.
- BRANCH (City, Street, Number, PostCode).
- PROJECT(Name, Budget, ReleaseDate).
- PARTICIPATION(Employee, Project, Startdate), with referential constraints between **Employee** and relation EMPLOYEE and between **Project** and relation PROJECT.

Exercise 7.3

Translate the E-R schema obtained in Exercise 6.6 into a relational schema.

Solution:

This is the schema obtained in Exercise 6.6:



Translation:

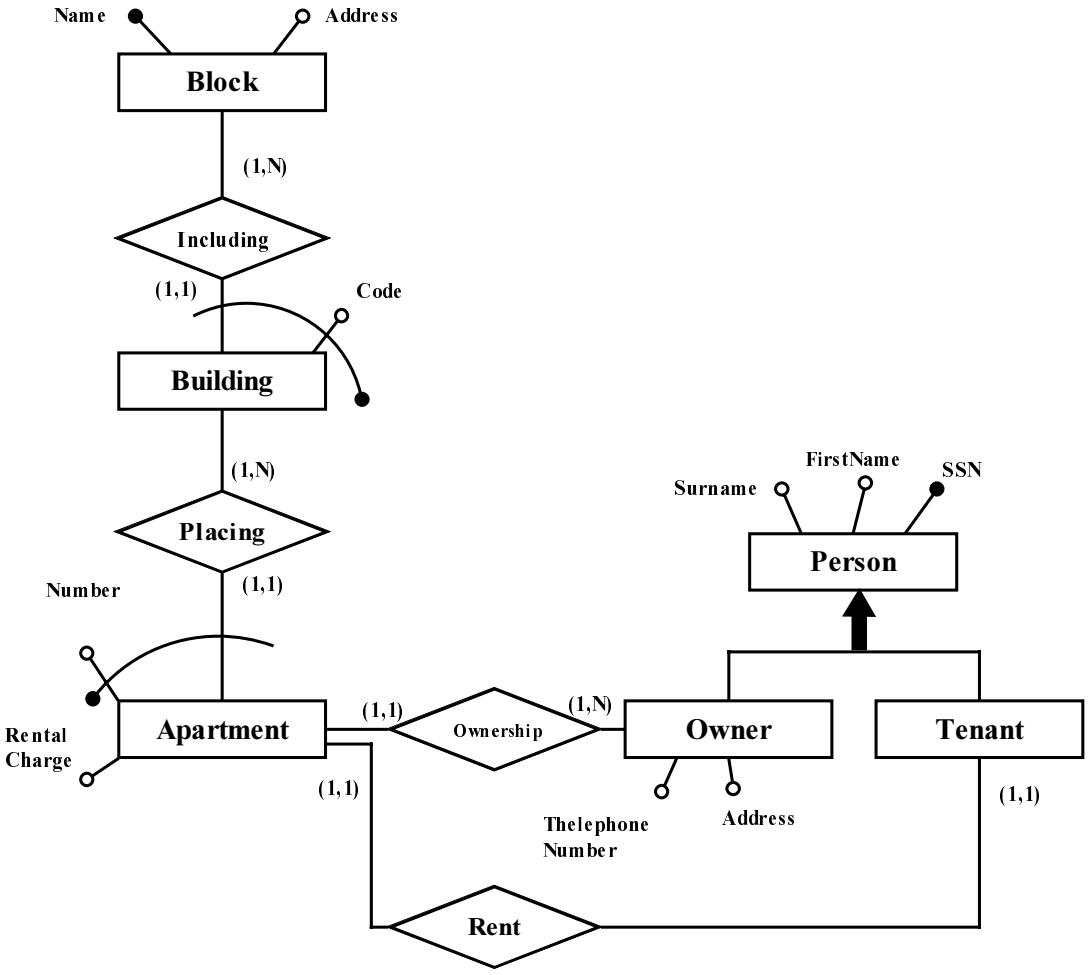
- REFEREE(SSN, Name, Surname, City, Region);
- DAY (Number, Series, Day, Month, Year);
- TEAM(Name, City, Trainer);
- PLAYER (SSN, FirstName, Surname, Position, BirthPlace, Day, Month, Year, Team), with referential constraints between **team** and relation TEAM;
- MATCH (Number, Dnumber, Dseries, Result, Referee, Home, Visiting), with referential constraints between **Dnumber, Dseries** and relation DAY, between **Referee** and REFEREE, and between **Home, Visiting** and relation TEAM;
- NEUTRALGROUND (Match, Number, Series, Reason, City) with referential constraints between **Match** , **Number** and **Series** and relation MATCH;
- POSTPONED (Match, Number, Series, Date) with referential constraints between **Match** , **Number** and **Series** and relation MATCH;
- POSITION (Team, Number, Series, Point), with referential constraints between **Team** and relation TEAM, and between **Number,Series** and relation DAY;
- PARTICIPATION (Player, Match, Number, Series, Position) with referential constraints between **Player** and relation PLAYER, and between **Match, Number, Series** and relation MATCH.

Exercise 7.4

Define a relational schema corresponding to the E-R schema obtained in Exercise 6.10. For the restructuring phase, indicate the possible options and choose one, making assumptions on the quantitative parameters. Assume that the database relates to certain apartment blocks, having on average five buildings each, and that each building has on average twenty apartments. The main operations are the registration of a tenant (50 per year per block) and recording the payment of rent.

Solution:

This is the schema obtained in exercise 6.10:



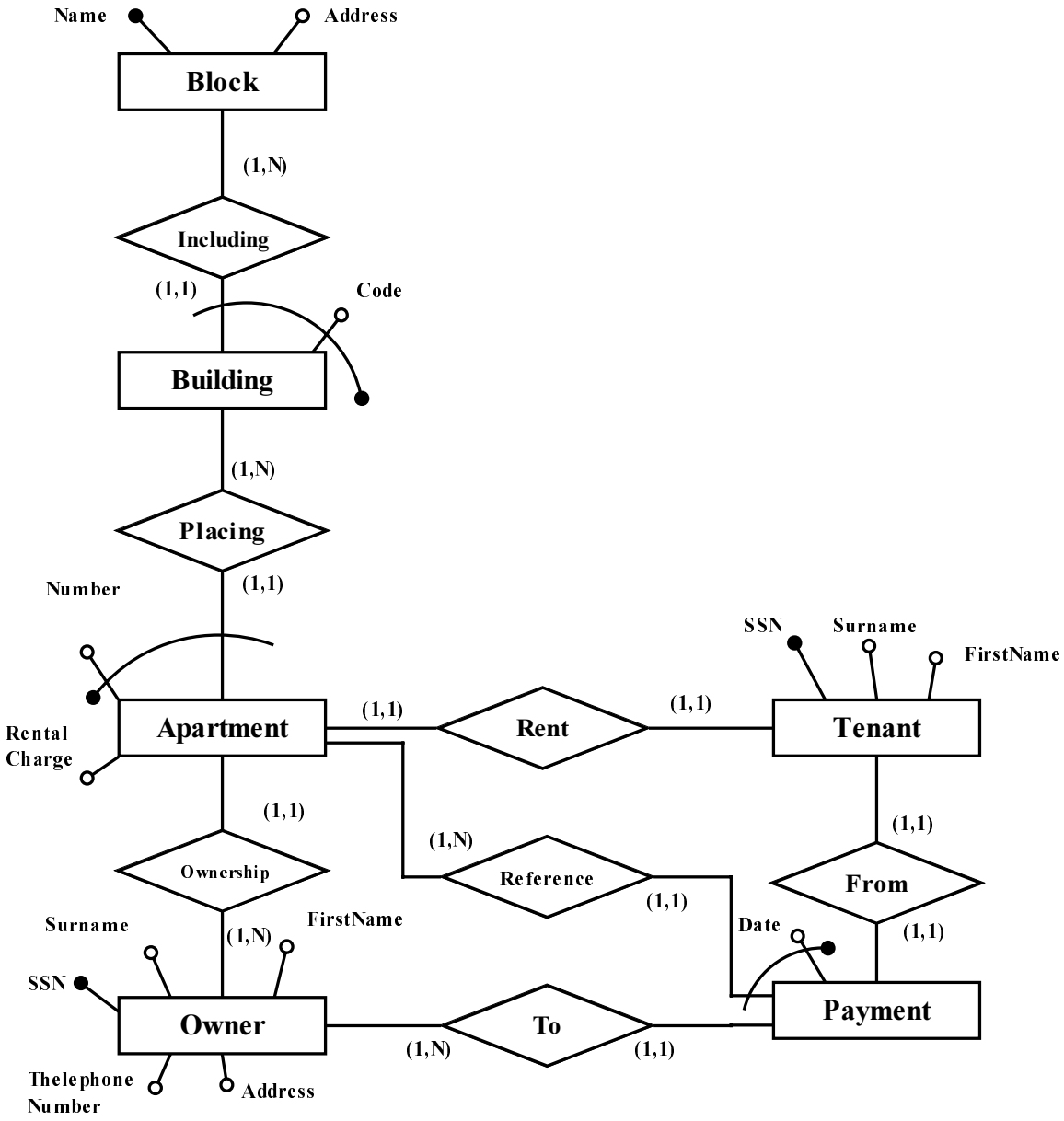
Supposing to have 100 apartments blocks, the volumes for this database are:

Volumes:

CONCEPT	TYPE	VOLUME
Block	E	100
Building	E	500
Apartment	E	10000
Person	E	15000
Owner	E	8000
Tenant	E	10000
Placing	R	10000
Ownership	R	10000
Rent	R	10000
Including	R	500

With these volumes, the first operation has a frequency of 500000 per year, whereas the second one 120000 per year.
The first operation suggests to remove the generalization on PERSON, leaving the two child entities TENANT and OWNER, because it refers only to the tenants, and not to all people; another possible choice would be to collapse the child entity into PERSON, but this would not be convenient, because owner and tenant are always involved in different operations. If there are owners who are also tenant of apartments, their information will be recorded two times, but this is an exceptional case.
The second operation suggests to introduce a new entity, PAYMENT, identified with date and the apartment to which the payment refers, and connected to TENANT and OWNER with relationship FROM and TO.

The restructured schema is:



The relational schema is:

- BLOCK (Name, Address);
- BUILDING (Code, Block), with referential constraint between **Block** and relation BLOCK;
- APARTMENT (Number, Building, Block, RentalCharge, Owner) with referential constraints between **Building, Block** and relation BUILDING, and between **Owner** and relation OWNER;
- TENANT (SSN, Surname, FirstName, Apartment, Building, Block), with referential constrains between **Apartment, Building, Block** and relation APARTMENT;
- OWNER (SSN, Surname, FirstName, Address, TelNumber);
- PAYMENT (Date, Apartment, Building, Block, From, To) with referential constrains between **Apartment, Building, Block** and relation APARTMENT, between **From** and relation TENANT and between **To** and relation OWNER;