## ✅ 1. Builder Design Pattern – Simple Definition

**Builder Pattern** is used to create **complex objects step by step**. It separates the construction of an object from its representation, allowing the same construction process to create different representations.

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## 🧠 Why Use It?

- When constructors have **too many parameters** (some optional).
- To avoid **telescoping constructors** like:

```
new Person("John", 25, "USA", null, null);
```

- Builder gives readable, flexible object construction.

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## 🚚 Real-Life Analogy

Imagine you're ordering a **custom burger**:

- Some people want only buns and patties.
- Others want cheese, lettuce, sauces, and extras.

A **burger builder** lets you pick components one by one, then build the final burger.

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## ✅ 2. Java Implementation – Basic Builder

### 🧑‍💻 Class: `User`

```
public class User {
    // Required parameters
    private final String username;
    private final String email;

    // Optional parameters
    private final String phone;
    private final String address;

    // Private constructor
    private User(Builder builder) {
        this.username = builder.username;
        this.email = builder.email;
        this.phone = builder.phone;
        this.address = builder.address;
    }

    // Static Inner Builder Class
    public static class Builder {
        private final String username;
        private final String email;
        private String phone;
        private String address;

        // Constructor for required fields
        public Builder(String username, String email) {
            this.username = username;
            this.email = email;
        }

        // Setters for optional fields (fluent style)
        public Builder phone(String phone) {
            this.phone = phone;
            return this;
        }

        public Builder address(String address) {
            this.address = address;
            return this;
        }

        // Final build method
        public User build() {
            return new User(this);
        }
    }

    // toString
    @Override
    public String toString() {
        return username + " | " + email + " | " + phone + " | " + address;
    }
}
```

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## ✅ Client Code

```
public class BuilderDemo {
    public static void main(String[] args) {
        User user1 = new User.Builder("john123", "john@example.com")
                .phone("1234567890")
                .address("New York")
                .build();

        User user2 = new User.Builder("alice456", "alice@example.com")
                .build();

        System.out.println(user1);
        System.out.println(user2);
    }
}
```

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## ✅ 3. Why This is Recommended in Effective Java (Joshua Bloch)

- Avoids telescoping constructors.
- Cleaner than JavaBeans (which allow inconsistent state).
- Thread-safe because object is immutable.

- Encourages fluent and readable code.

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## ✅ 4. Considerations for Builder Pattern

| Concern | Recommendation |
|---|---|
| **Too many parameters** | Use Builder to clearly distinguish required vs optional parameters |
| **Immutability** | Make your object `final` and fields `private final` |
| **Thread Safety** | Immutable objects created via builder are naturally thread-safe |
| **Validation** | Add validation inside `build()` or constructor (`null checks`, etc.) |
| **Cost** | Slightly more verbose/extra class but worth the clarity |
| **JavaBeans vs Builder** | Builder avoids mutability and broken intermediate states |

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## 🔁 Builder Pattern vs Other Patterns

| Pattern | Comparison with Builder |
|---|---|
| Factory | Focuses on **which** object to create |
| Abstract Factory | Creates families of objects |
| Prototype | Clones object state |
| Builder | Builds **one complex object** in multiple steps |

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## ✅ Summary of Key Points

- Use Builder when:
  - Object has **many optional parameters**
  - You want **immutable objects**
  - You want **fluent and readable** object construction
- **Static Inner Class Builder** (as per *Effective Java*) is:
  - Thread-safe
  - Clean separation of required and optional params
  - The **most idiomatic** way in modern Java

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