


Erasmus+ Project

Learn Deep Project

Cooperation Partnerships in Vocational Education and Training

2023-1-TR01-KA220-VET-000150804

CAPTURING THE KNOW-HOW OF PROFESSIONALS IN CONSTRUCTION USING ONLINE LEARNING

Interdisciplinary Courses

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Erasmus+ Project

Project “Learn Deep Project Discover the Know-How of Construction Professionals”, 2023-1-TR01-KA220-VET-000150804. Cooperation partnerships in vocational education and training projects.

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Partners:	**Zonguldak Bulent Ecevit University**
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1 Introduction

The modern construction industry stands at a crossroads where traditional engineering meets the urgent demands of the digital age and the climate crisis. The era of the "siloed" engineer focused solely on statics and mechanics is ending. In its place emerges a new paradigm where civil engineering is deeply intertwined with information technology, environmental science, and advanced safety protocols. To remain relevant and responsible, today's professionals must be fluent in multiple languages: the language of code, the language of carbon, and the language of safety.

This Intellectual Output, titled "Interdisciplinary Frontiers in Civil Engineering," is designed to break down the barriers between distinct academic disciplines. It recognizes that a building is no longer just a physical asset; it is a digital twin, an environmental intervention, and a workplace. This curriculum bridges these domains to cultivate a holistic understanding of the built environment.

The modules curated under this "Interdisciplinary Courses" framework act as the connective tissue of the project, structured around three transformative pillars:

Digital Transformation & BIM (The Digital Twin): The construction site is becoming data-driven. Courses such as BIM Technologies in Precast Industry and BIM Level of Development (LOD) move students beyond simple CAD drafting into the realm of intelligent modeling. Furthermore, From Structures to Data: A Civil Engineer's Journey into IT highlights the critical convergence of coding and construction, preparing engineers to automate workflows and manage complex datasets.

Sustainability and Environmental Stewardship: With the construction sector responsible for a significant portion of global emissions, sustainability is no longer optional it is an imperative. The curriculum addresses this through Environment and Construction Sector and Sustainable Construction, while specialized modules like Sustainable Geotechnics demonstrate how innovative ground engineering can reduce environmental impact.

Occupational Health & Safety (The Human Element): Technology and sustainability mean nothing if the workforce is not protected. This pillar emphasizes that safety is an interdisciplinary ethical mandate. Through Introduction to OSHA, Health and Safety at Heights, and Selected Aspects in Construction, students learn that safety design is integral to the engineering process, not an afterthought.

By integrating these diverse fields, this output aims to produce "Future-Proof" engineers. It equips them with the agility to navigate the Twin Transition (Green & Digital), ensuring they can design structures that are not only physically sound but also digitally intelligent, environmentally regenerative, and inherently safe for all stakeholders.

For more information about the project, please visit its official website:

https://www.civilengknowhow.com/

MOODLE platform:
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Electrical Installation Project Reading

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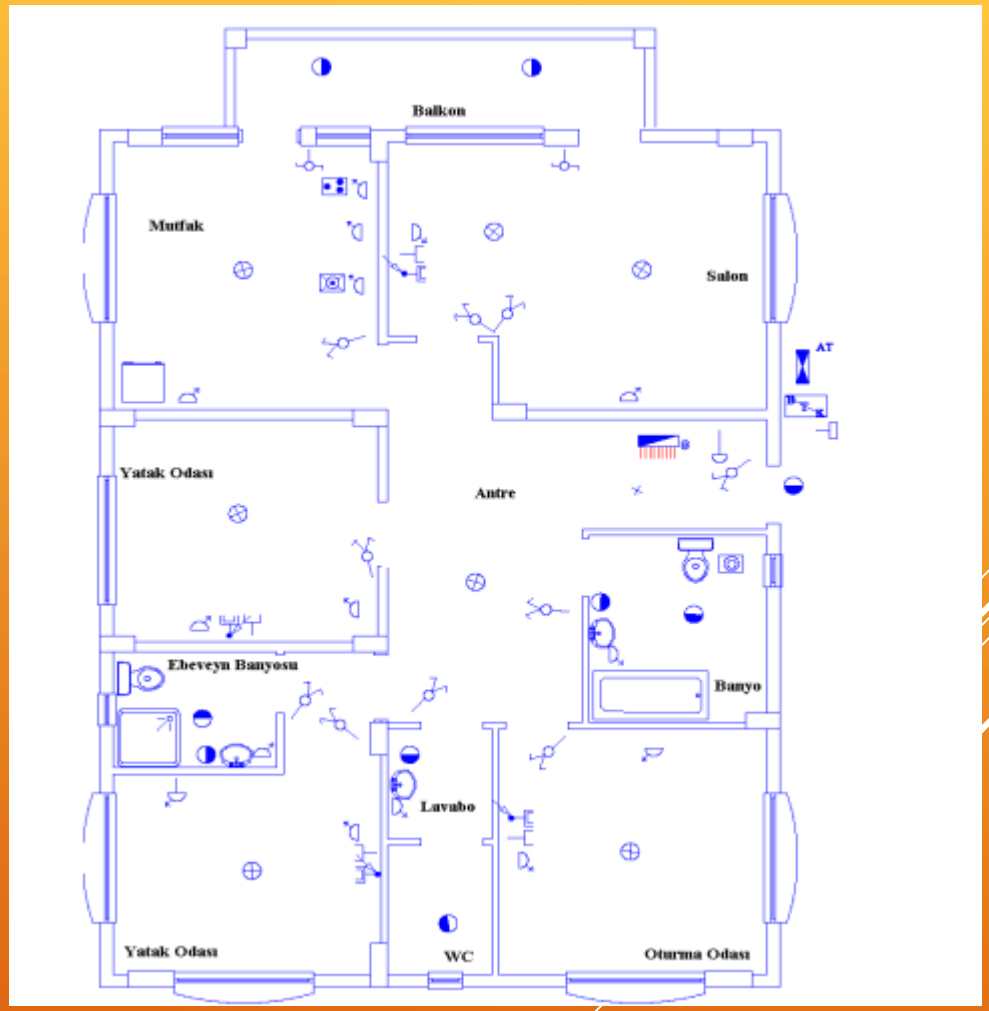
- **Design Principles, Components, and Drawing Standards**

- Welcome everyone. Today, we will dive deep into the technical aspects of Electrical Installation Projects. We will cover everything from the fundamental components and materials to the specific drawing standards used in architectural integration. This presentation is based on the technical regulations for indoor installations."



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: Introduction & Scope

- To learn how to draw and design electrical projects on architectural plans according to scale.

- Installation Symbols & Scales.
- Weak vs. Strong Current Materials.
- Project Design (Column, Circuit, and Branch Lines).
- Calculations and Standards (TSE/ISO).

"Our primary objective is to enable you to design electrical projects that fully integrate with architectural plans. We will explore the standards set by the Turkish Standards Institute (TSE) and ISO. By the end of this session, you will understand the distinction between weak and strong currents and how to structure a project from the main power supply down to the final light switch."

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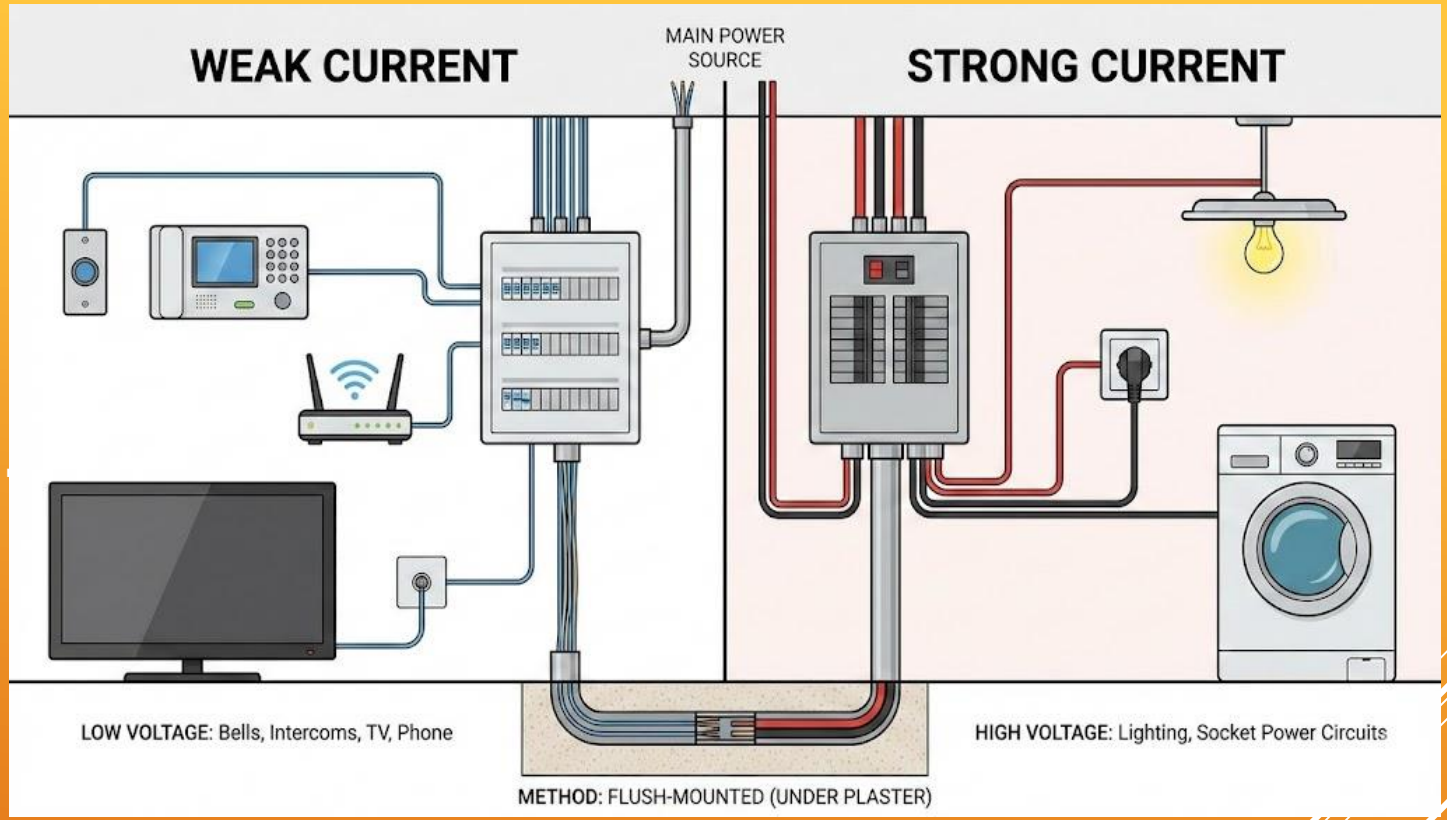
Basics of Electrical Installation

- The complete system comprising lighting, sockets, bells, telephone, and antenna networks.

- **Weak Current:** Low voltage (Bells, Intercoms, Phone).
- **Strong Current:** Lighting and Socket power circuits.



"An electrical installation isn't just about power. It is divided into two main categories: Weak Current and Strong Current. Weak current covers low-voltage systems like your doorbell, intercom, and data lines. Strong current handles the heavy lifting—your lighting and power sockets. In modern construction, these are almost always installed 'flush-mounted,' meaning they are hidden beneath the plaster."

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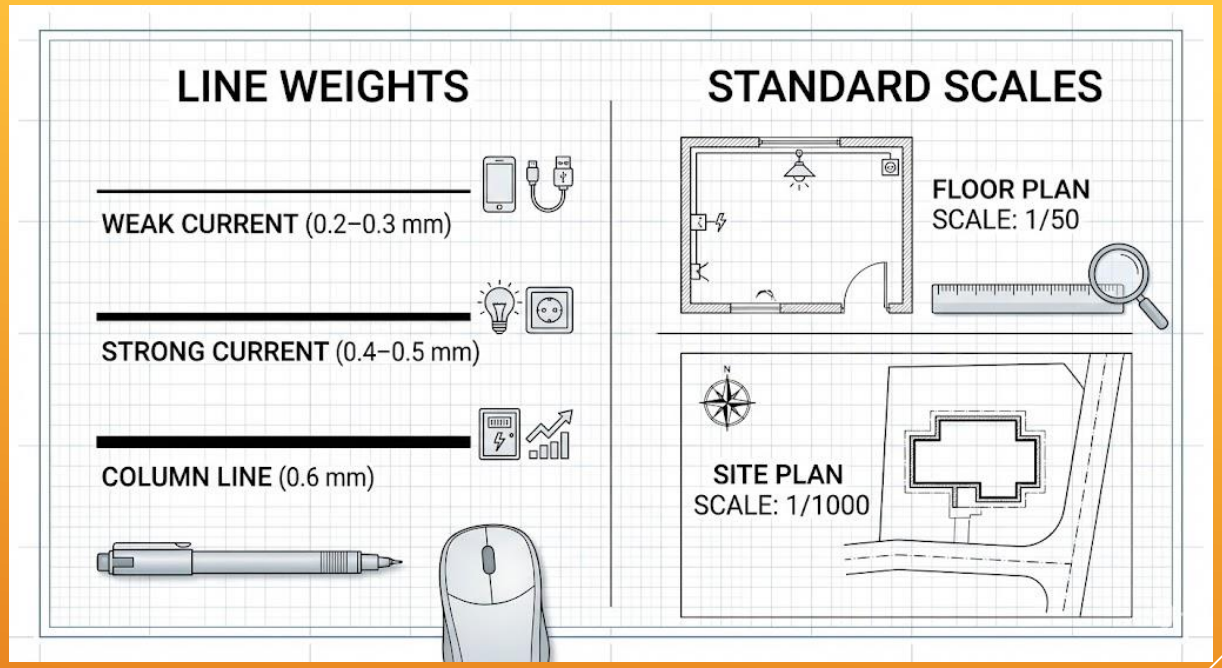
Drafting Standards & Scales

- **Line Weights:**
  - Weak Current: 0.2–0.3 mm.
  - Strong Current: 0.4–0.5 mm.
  - Column Lines: 0.6 mm.
- **Standard Scales:**
  - Floor Plans: 1/50.
  - Site Plans: 1/1000.



"Precision is key in engineering. Whether drawing by hand or using CAD software like AutoCAD, line weights matter. We use thicker lines, around 0.6 mm, for main column lines to denote hierarchy, while weak current lines are thinner. The industry standard scale for floor plans is 1:50, ensuring that electricians can read the placement of every component clearly."

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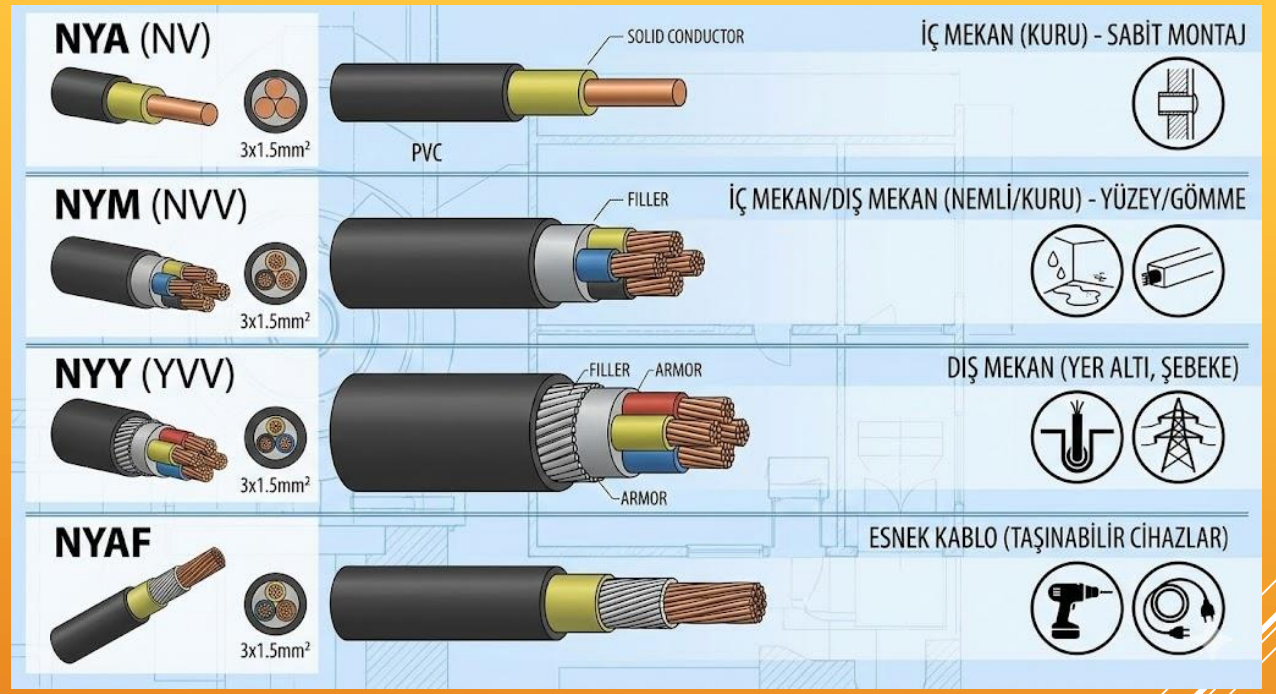
Power Conductors (Cables)

- **Conductors:** Wires carrying current, either bare or insulated.
- **Common Types :**
  - **NYA (NV):** PVC insulated, used in dry indoor areas (fixed installation).
  - **NYM (NVV):** For damp or dry areas, surface or flush mounted.
  - **NYY (YVV):** Underground cable for outdoor mains (low voltage).
  - **NYAF:** Flexible cable for moving devices.



- "Let's talk about the veins of the system: the cables. The most common type you will encounter in indoor housing projects is the NYA cable, used in dry, fixed locations. For areas requiring more protection or surface mounting, we use NYM. For underground outdoor power transmission, the robust NYY cable is the standard."

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Weak Current & Data Cables

- **Communication & Data:**
  - **PDV:** Indoor telephone installations.
  - **RG6 / RG59:** Coaxial cables for TV and antenna systems.
  - **Cat5/Cat6:** Data transmission and electronic building control.
  - **CCTV:** Dedicated video cables for security cameras.

"For communication, we use specific cables. PDV is your standard telephone wire. For television, we rely on coaxial cables like RG6. And critical for modern smart buildings are the Cat5 and Cat6 cables, which handle high-speed data transmission and building control systems."

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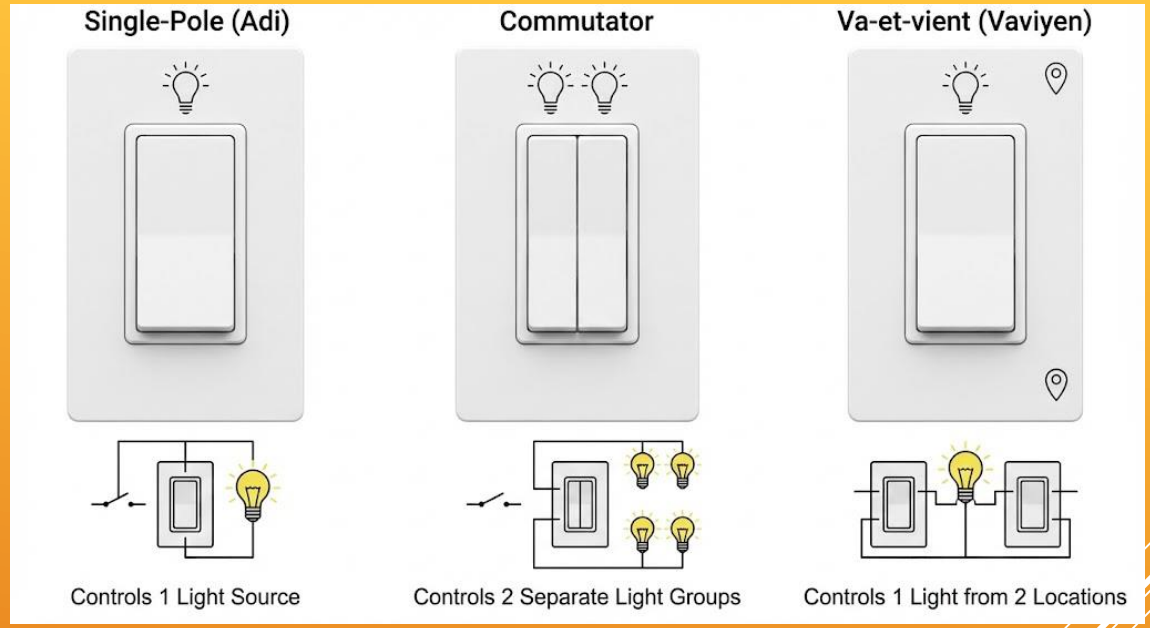
Connection Elements

- **Terminals (Klemens):** Used to join wires securely. Twisting thick wires is unsafe; terminals provide a rigid connection.
- **Safety:** Wires of different cross-sections should be joined using terminals to ensure tight contact.
- **Cable Lugs (Pabuç):** Used for connecting thick, multi-strand cables to devices to ensure mechanical stability.



- "Connections are the weak points of any circuit if done poorly. We never simply twist thick wires together. We use 'Klemens' or terminals. For thicker, multi-strand cables, we must use cable lugs, or 'pabuç', to ensure the connection is mechanically strong and electrically sound."

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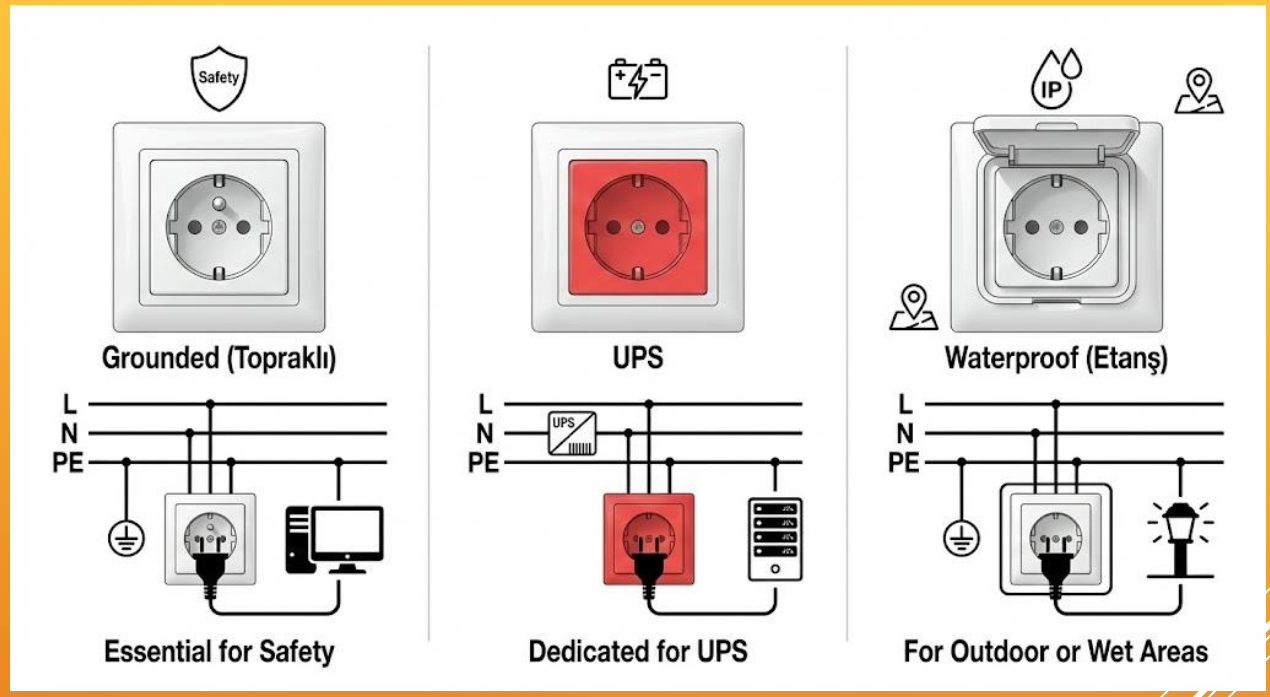
: Conduits and Protection

- To protect conductors from mechanical damage and environmental hazards.
  - **PVC Rigid Pipes:** Fire-retardant, corrosion-resistant.
  - **Spiral (Flexible) Pipes:** Used in areas requiring bends or vibration resistance.
  - **Diameters:** Standard sizes include 14, 18, 26, and 32 mm.



- "Cables are never left exposed in a wall. They run through conduits. We primarily use rigid PVC pipes which are fire-retardant. However, where the route bends sharply or needs flexibility, we use spiral pipes. Standard diameters like 14mm and 18mm are chosen based on the number and thickness of wires inside."

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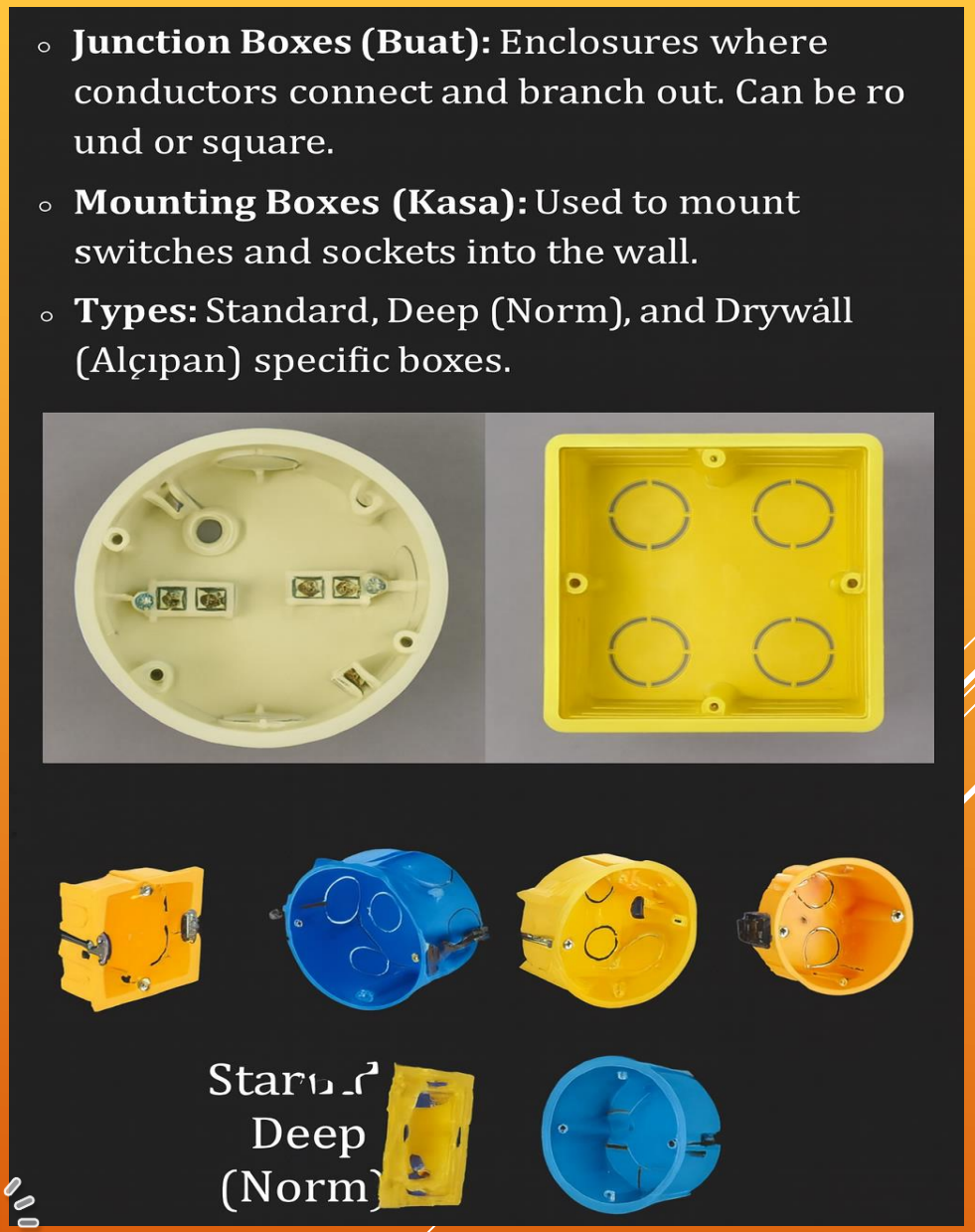
: Installation Boxes

- **Junction Boxes (Buat):** Enclosures where conductors connect and branch out. Can be round or square.
- **Mounting Boxes (Kasa):** Used to mount switches and sockets into the wall.
- **Types:** Standard, Deep (Norm), and Drywall (Alçıpan) specific boxes.

"The 'Buat' or junction box is where the magic of distribution happens—it's where wires branch out. For the user interface—the switches and sockets—we use mounting boxes or 'Kasalar'. It is crucial to select the right box type, for example, using specific drywall boxes for gypsum walls."



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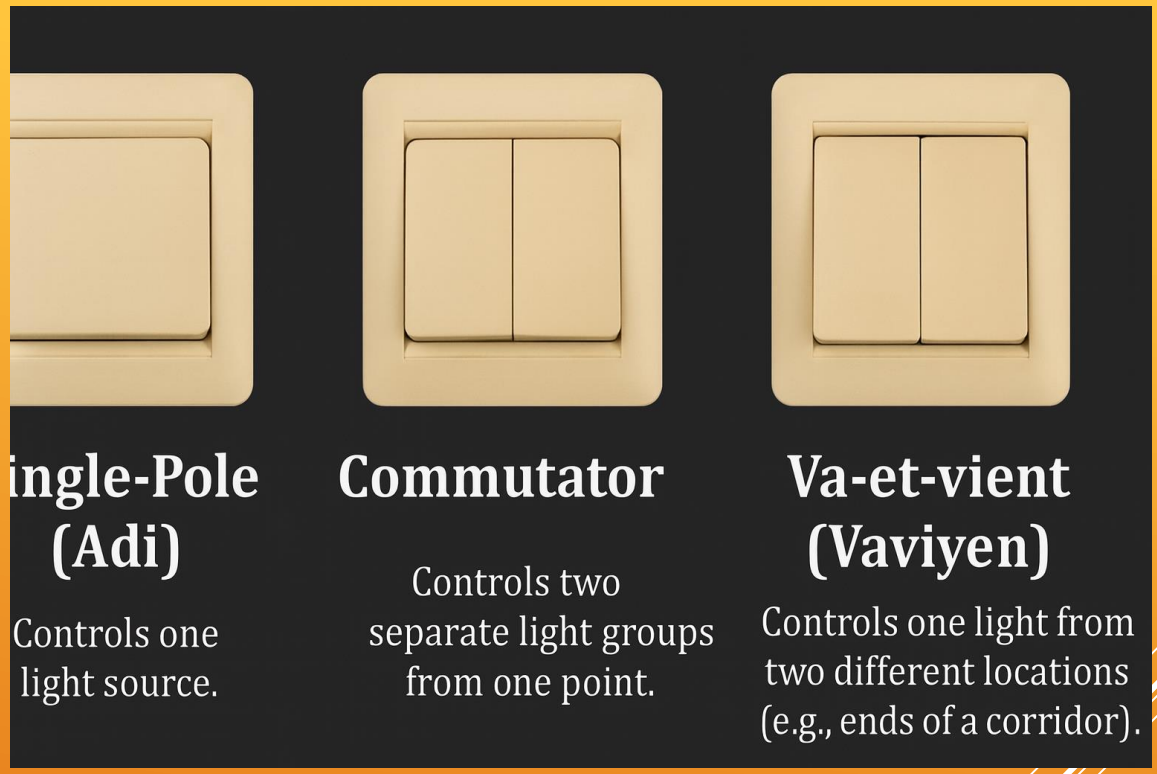
Switches

: Manually opening and closing the circuit

- **Single-Pole (Adi):** Controls one light source.
- **Commutator:** Controls two separate light groups from one point.
- **Va-et-vient (Vaviyen):** Controls one light from two different locations (e.g., ends of a corridor).



- : "You are all familiar with switches, but in design, selection is key. A single-pole switch controls one lamp. A commutator controls two groups—like a chandelier. And for corridors, we use the 'Vaviyen' or two-way switch, allowing control from both ends of the hall."

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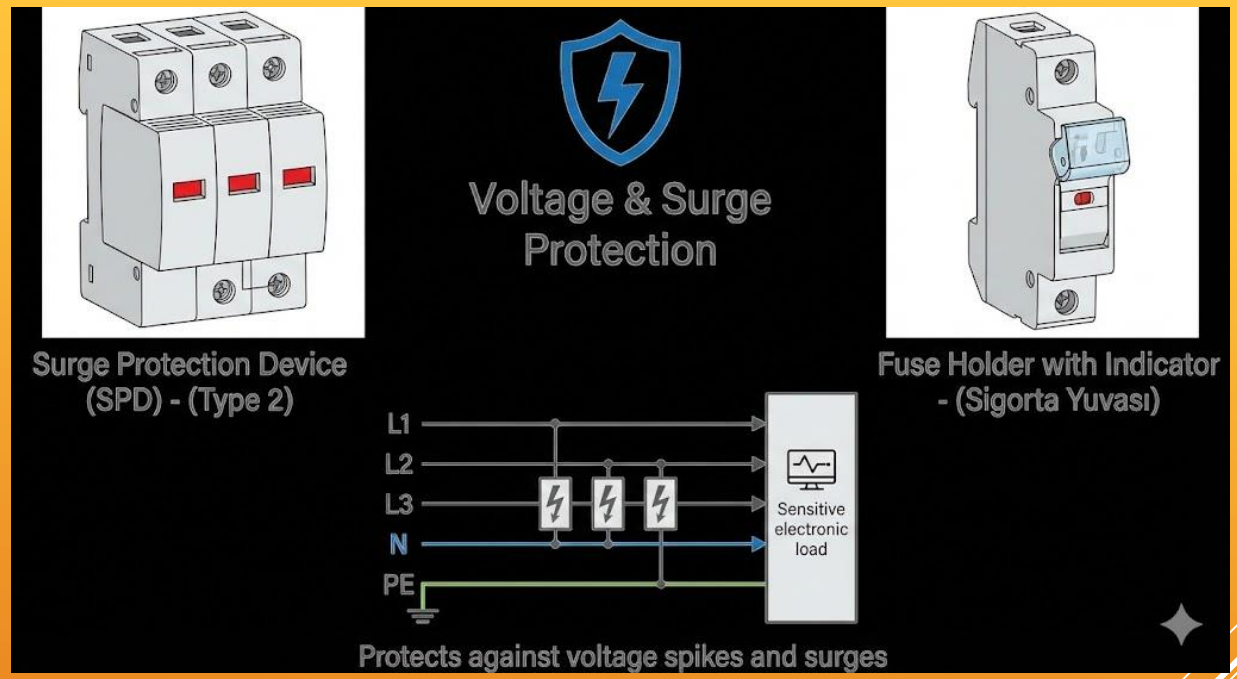
: Sockets (Power Outlets)

- Typically constructed from rigid PVC or thermoplastic.
  - **Grounded (Topraklı):** Essential for safety.
  - **UPS:** Dedicated for uninterruptible power supplies.
  - **Waterproof (Etanş):** For outdoor or wet areas.
- **Rule:** High-power appliances (ovens, washing machines) need independent lines.



- **:** "Sockets provide the interface for appliances. Safety mandates grounded sockets in almost all modern applications. In wet areas, waterproof or 'etanş' sockets are required. Crucially, high-power devices like washing machines must have their own dedicated circuit lines—they cannot share power."

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Lighting Components

- **Lamps:** Devices converting electrical energy to light (Incandescent, Fluorescent, LED, Halogen).
- **Armatures:** Fixtures that hold the lamp and provide protection.
- **Sockets (Duylar):** The interface between the installation and the lamp (Porcelain, Bakelite).

: "Lighting design involves the lamp, the socket (duy), and the armature. While we have various lamp types like LED and fluorescent, the armature is what gives the aesthetic and protection. In technical drawings, we use specific symbols to denote whether a fixture is wall-mounted (sconce) or ceiling-mounted."

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Protection: Fuses & RCDs

- **Fuses (Sigortalar):** Protect against overloads and short circuits.
- **Residual Current Device (Kaçak Akım Rölesi):**
  - Detects leakage currents to prevent electric shock and fire.
  - **30 mA:** Life safety protection.
  - **300 mA:** Fire protection (main column input).

: "Protection is non-negotiable. Fuses protect the wires from melting due to overload. But for human safety, we use the Residual Current Device, or RCD. A 30mA RCD saves lives by cutting power if it detects a leak through a person. A 300mA RCD prevents electrical fires."

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Grounding System

- **Purpose:** Connects devices to the earth via a conductor.
- **Materials:** Copper, Galvanized Steel (Strip, Rod, or Plate electrodes).
- **Minimum Cross-sections:**
  - Copper: 16 mm^2.
  - Aluminum: 35 mm^2.
  - Steel: 50 mm^2.

"A grounding system ensures that leakage currents have a safe path to the earth. We use copper or galvanized electrodes driven into the ground. The conductor connecting the system to the ground must be substantial—at least 16 mm^2 if using copper—to handle fault currents safely."

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Project Hierarchy: The 4 Lines

- 1. Main Column Line: From utility network (TEDAŞ) to building Main Panel.
- 2. Column Line: From Main Panel to apartment Distribution Panel.
- 3. Linye (Circuit Line): From Distribution Panel to the junction box.
- 4. Sortie (Branch Line): From junction box to the final device (Lamp/Socket).

- "When designing, you must understand the hierarchy. Energy flows from the Utility Network to the Main Panel via the 'Main Column Line.' From there, it goes to your apartment's fuse box via the 'Column Line.' Inside the apartment, the 'Linye' takes power to a junction box, and finally, the 'Sortie' connects the actual device."

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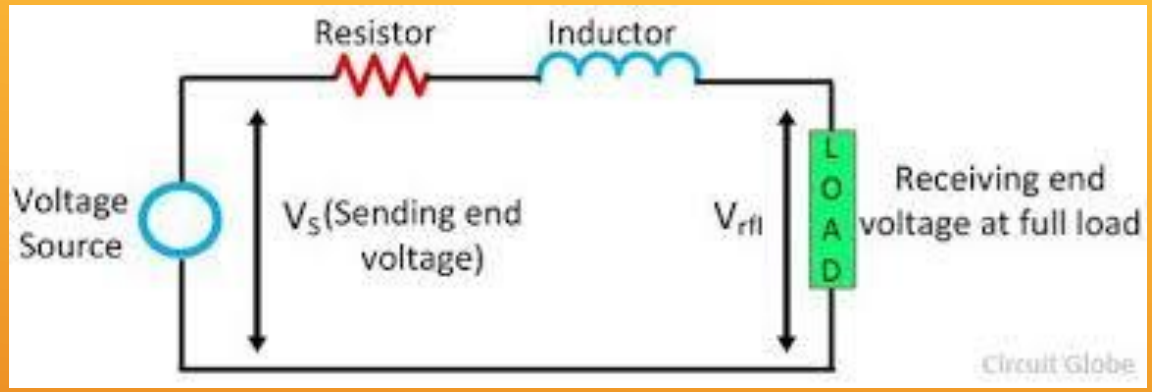
Linye (Circuit Line) Rules

- **Separation:** Lighting and Socket lines must be separate circuits.
- **Capacity:**
  - Max **9** lighting points per lighting linye.
  - Max **7** sockets per socket linye.
- **Protection:**
  - Lighting: Max 10A fuse.
  - Sockets: Max 20A fuse.



- "Designing 'Linye' lines has strict rules. You cannot mix lights and sockets on the same fuse. A lighting circuit can support up to 9 lamps, protected by a 10A fuse. A socket circuit supports up to 7 outlets, protected by a maximum 20A fuse to prevent overheating."

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Sortie Types (Branch Lines)

- **Definition:** The final line segment connecting the load.
- **Cable Specs:** Lighting min 1.5 mm^2; Sockets min 2.5 mm^2.
- **Types:**
  - **Normal Sortie:** 1 switch, 1 lamp.
  - **Commutator Sortie:** 1 switch, 2 separate lamp groups.
  - **Va-et-vient Sortie:** Two switches controlling one lamp.

: "The 'Sortie' is the final leg of the journey. For lighting, we use 1.5 mm^2 cables. For sockets, which draw more power, we use 2.5 mm^2. Depending on the switch type—standard, commutator, or va-et-vient—the wiring configuration changes, as shown in these diagrams."

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: Design & Placement Rules

- **Switches:** Place on the opposite side of the door swing direction.
- **Specifics:**
  - Bathroom/WC switches: Outside the room.
  - Balcony switches: Inside the room.
- **Sockets:** At least one per room; min. two for salons/kitchens.

- "Placement is about usability. Switches should always be on the latch side of the door, not behind the hinge. Safety dictates that bathroom switches stay outside the wet zone. Conversely, balcony switches stay inside to protect them from weather."

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: Weak Current Systems (Home Automation)

- **Intercoms (Diyafon):** Audio/Video communication, efficient communication.
- **Door Opener (Otomatik):** Remote mechanism to open main doors.
- **Staircase Timer:** Automates lighting in common areas.

- **:** "Modern buildings rely heavily on weak current systems. The intercom, or 'diyafon', allows residents to verify visitors via audio or video. We also integrate automatic door openers and staircase timers to improve security and energy efficiency in common areas."

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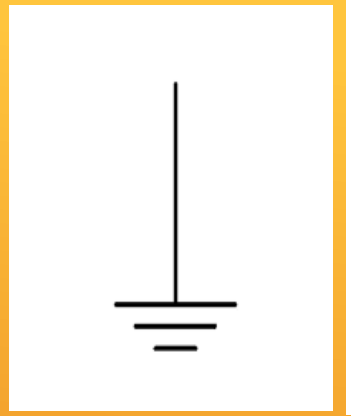
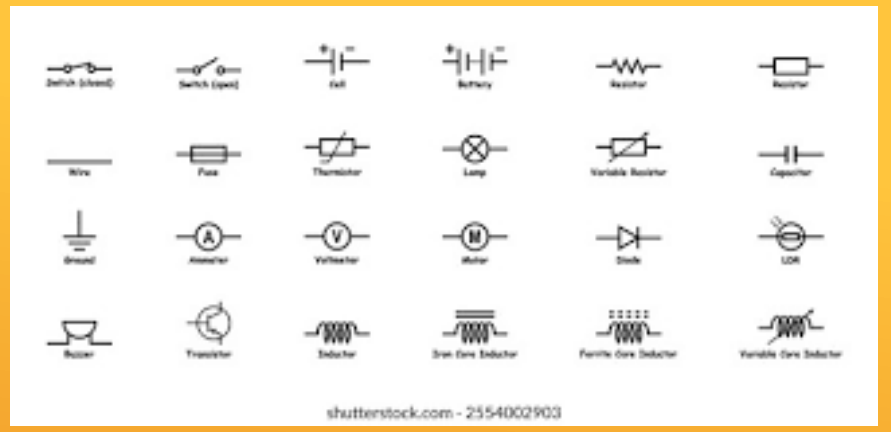
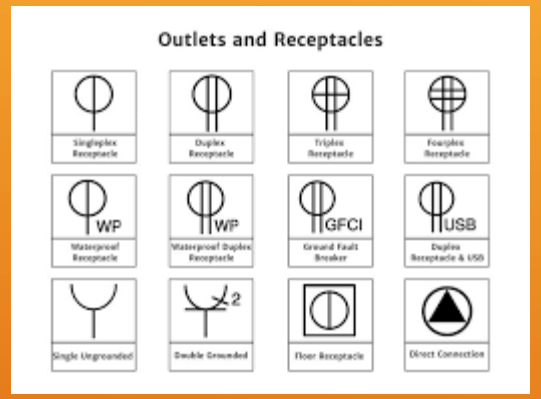
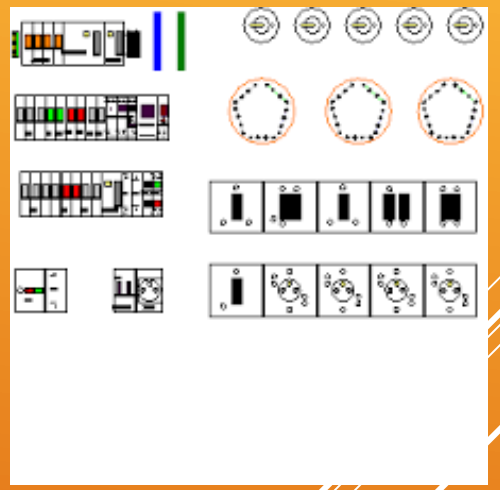
Reading Symbols (The Legend)

- **Standardization:** Correct symbols are crucial for universal readability.
- **Key Symbols:**
  - **Grounding:**
  - **Commutator Switch:**
  - **Grounded Socket:**
  - **Distribution Board:**









: "Finally, a project is only as good as its readability. We use standardized symbols found in Tables Whether it's a grounded socket or a distribution board, using the correct symbol ensures that any engineer or electrician can understand your design without confusion."

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Steel Structure Project Details and Drawing Reading for site engineer

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Steel structures are one of the most efficient and durable systems in modern construction.
Throughout this presentation, we will explore how to correctly interpret steel project drawings, understand their details, and apply them accurately in the field.
By the end, you'll have a clearer perspective on how design data transforms into real-life steel constructions."

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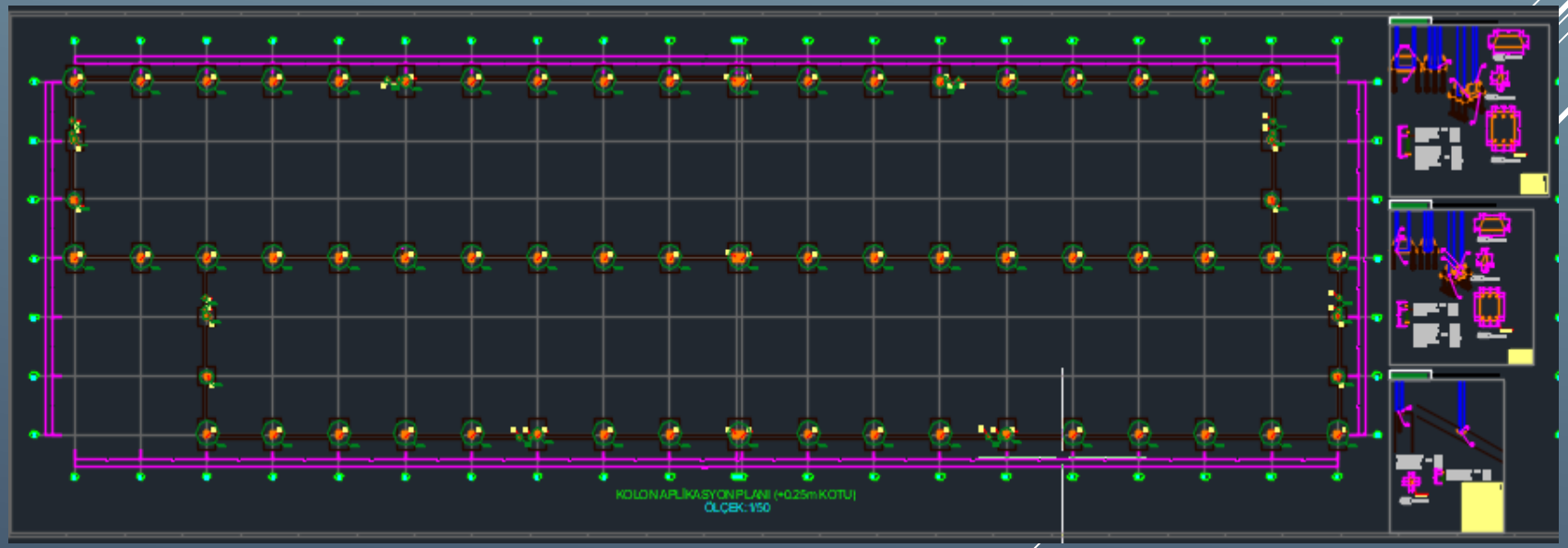
•Reading the DWG (CAD) drawings of a steel construction project means understanding not just the lines themselves, but the engineering intent and implementation instructions behind them. It is a critical skill for progressing in the field without errors, increasing efficiency, and ensuring safety.



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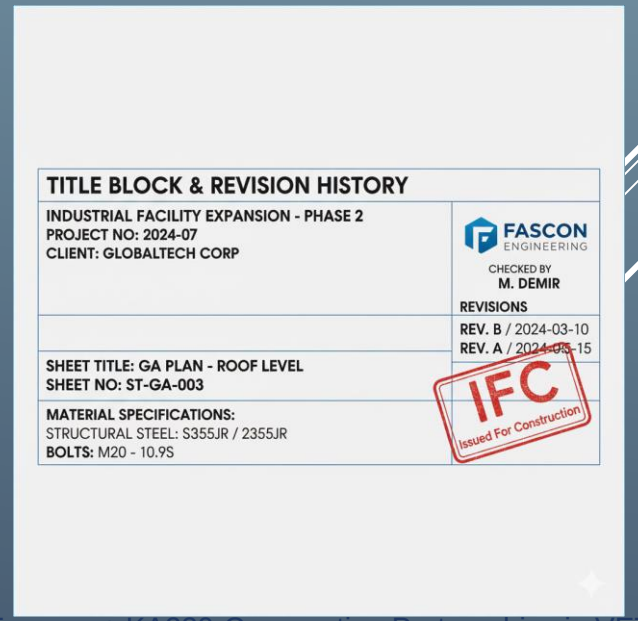
- **Step 1: Understanding the Title Block and Basic Project Information**
- When you open a DWG drawing, the first place you should look is the title block — the ID card of the drawing.
- **Technical Explanation:**
  The title block provides the context, currency, and general information of the project. Revision information is especially vital to ensure that you are using the most up-to-date drawing on site. Using an outdated revision can result in incorrect fabrication or assembly, leading to serious costs. The scale information is also essential for mentally visualizing the real dimensions of the details in the drawing.



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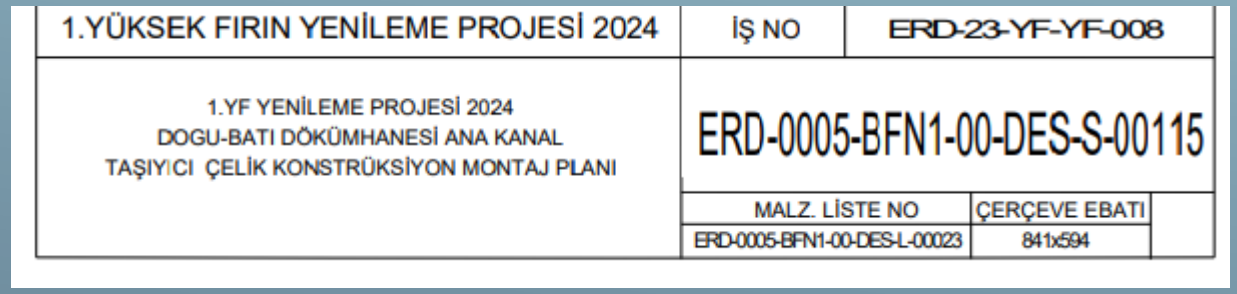
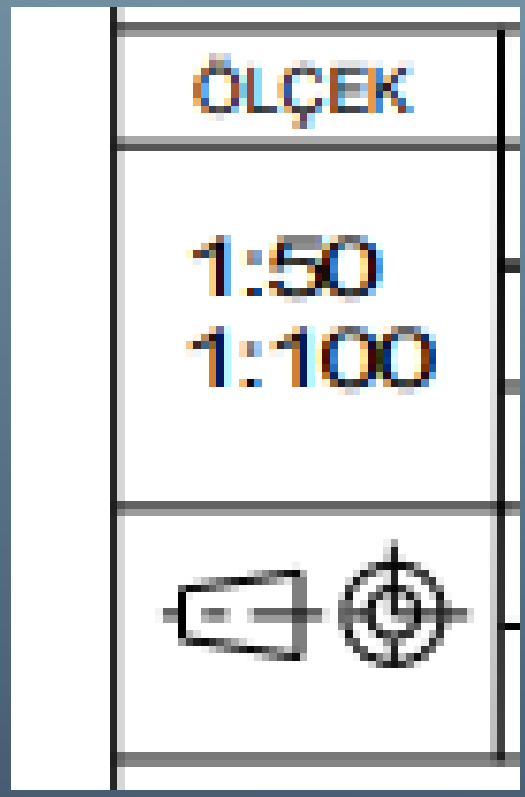
- **Key Points to Pay Attention To:**
- **Project Name/Number and Drawing Name/Number:** Clarifies which part of which project you are examining. In large projects, understanding the drawing numbering system is important (e.g., ST-GA-001: Structural – General Arrangement – Drawing 001).
- **Scale:** The drawing's scale (e.g., 1:50, 1:20) gives an idea of proportions for details that aren't dimensioned. In detailed drawings (1:10, 1:5), the scale also helps with visual checks.





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- **Revision Date and Number:** This is the most critical information. Look for notes such as REV. 01, REV. A, IFC (Issued For Construction). Always check the main revision table of the project and make sure you are using the latest revision. Using outdated revisions can cause serious site clashes or incorrect fabrication/installation.
- **Drawn By, Checked By, Approved By:** Shows the chain of responsibility behind the drawing and identifies who to contact in case of an issue.
- **Material Grades :** Key material information such as steel quality (e.g., S355JR, S235JR), bolt grades (e.g., 8.8, 10.9), and welding electrodes (e.g., E70XX) are listed here or in the general notes. This directly affects material procurement and quality control.

GENEL NOTLAR:
BELİRTİLMEYEN DELİKLER : 22
BELİRTİLMEYEN KAYNAKLAR a=0,7 * t min

1 ADET B1 İÇİN MALZEME LİSTESİ — TOPLAM 2 ADET GEREKLİDİR

Poz No	Profil	Boy	Adet	Kalite	Ağırlık / Ad.	Ağırlık
P/9	IPE140	2037	1	S235JR	25.33	25.33
					TOPLAM :	25.33

İş No.	DEĞİŞMELER	İMZA	TARİH

ETÜD-PROJE	17.09.2024	
RESİM	17.09.2024	
ÖLÇEK	1.YÜKSEK FIRIN YENİLEME PROJESİ 2024 DOGU-BATI DÖKÜMHANESİ ÇELİK İMALAT DETAYLARI	ERD-0005-BFN1-00-DES-S-00116 [B1]
1:5		ÇERÇEVE EBATI 594x420

KYS.FRM.01330 REV.0

Drawn By, Checked By, Approved By

Material Grades

Scale

Project Name/Number and Drawing Name/Number

Revision Date and Number

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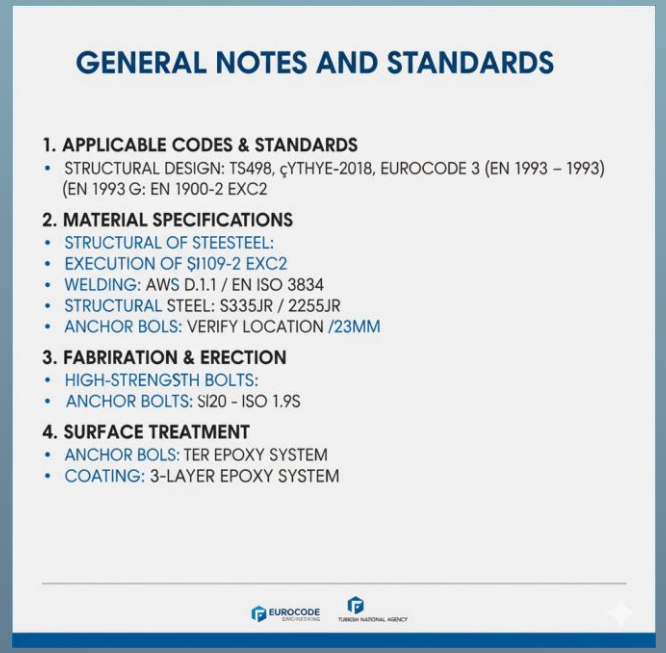
- **Step 2: Reviewing General Notes and Standards**
- Every project has its own specific implementation principles and reference standards. These are usually listed on the opening sheets of the drawings or in the **"General Notes"** section.
- **Technical Explanation:**
  General notes define the **"construction rules"** and acceptance criteria of the project. For example, they may specify that all welds must comply with AWS D1.1 (Structural Welding Code – Steel) or EN ISO 3834; bolt tightening must follow AISC Specification guidelines; and corrosion protection should be applied using a specified coating system (e.g., three-layer epoxy).
  These notes form the foundation of your quality control processes and indicate which procedures and tolerances must be followed. Non-compliance with these standards can cause serious issues in permitting, inspection, and acceptance stages of the project.



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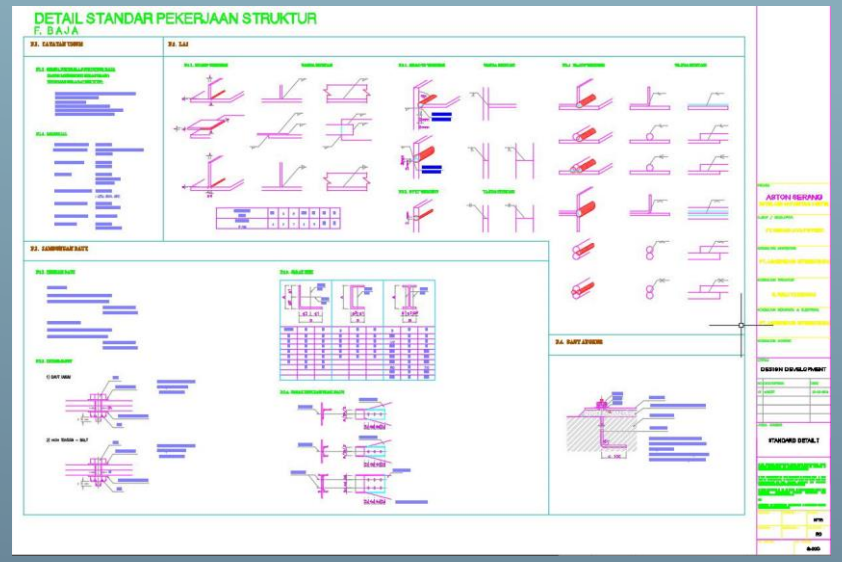
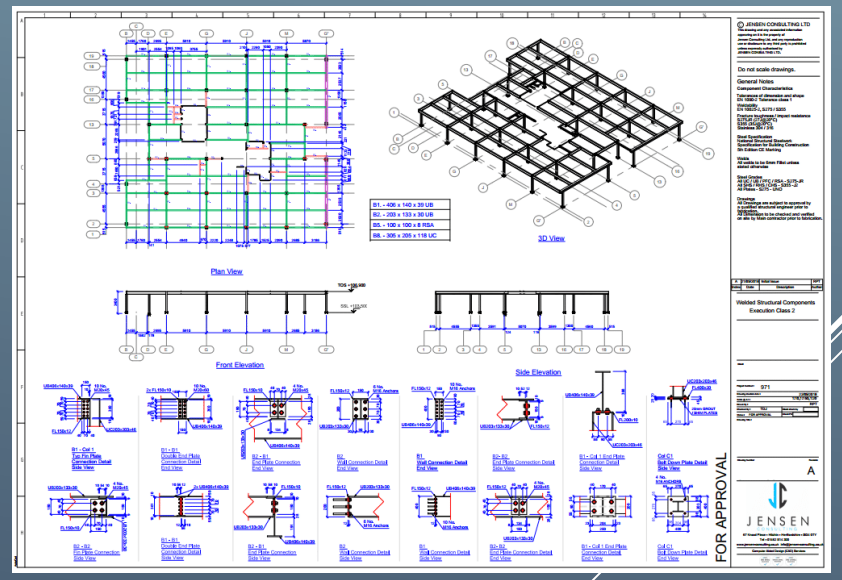
- **Key Points to Pay Attention To:**
- **Design Standards:** Which national or international codes have been used (e.g., ÇYTHYE-2018, Eurocode 3 – EN 1993, AISC 360)? This gives insight into load combinations and the structural design philosophy.
- **Fabrication and Erection Standards:** Particularly standards like EN 1090-2 (Execution of Steel Structures and Aluminium Structures). These contain binding requirements on weld quality, bolt tightening procedures, and erection tolerances.





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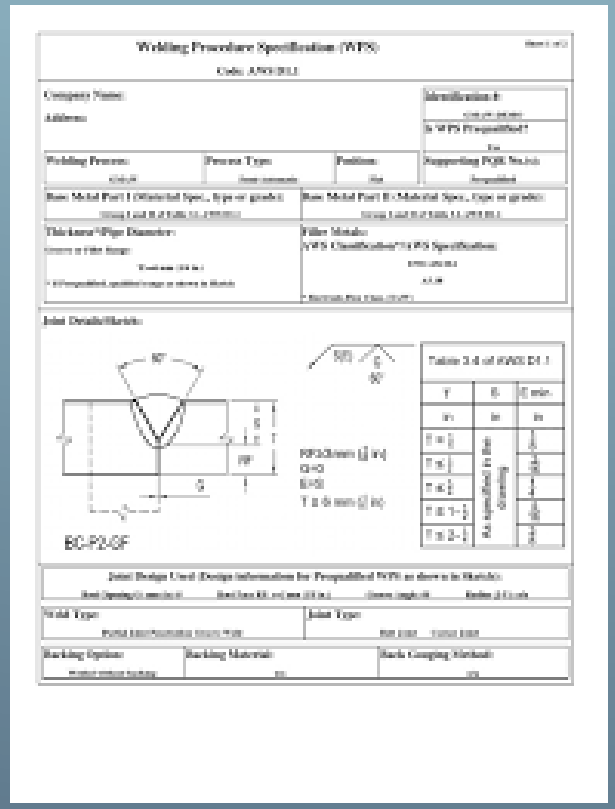
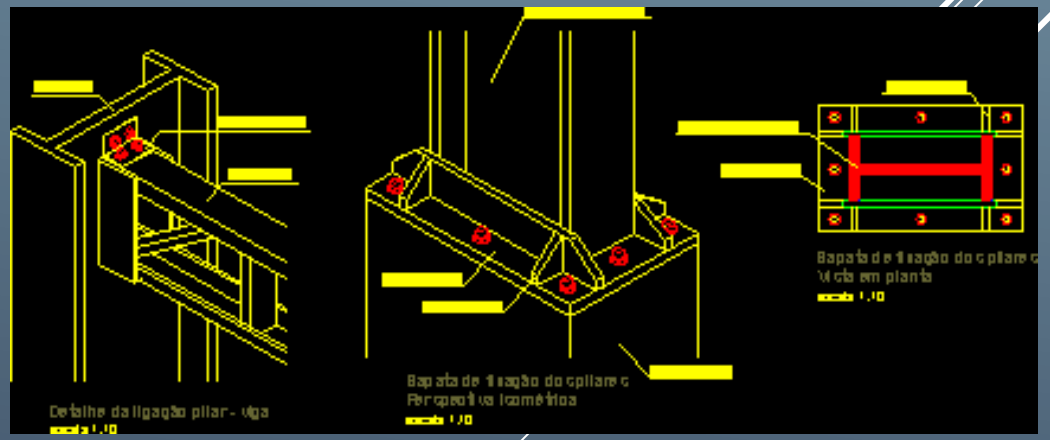
- **Welding Procedures (WPS – Welding Procedure Specification):** Defines how welds must be performed, which electrodes are used, and the required current and voltage values. Different WPS documents may exist for each weld type (e.g., fillet, groove).
- **Surface Treatment and Protection:** Details of corrosion protection (e.g., SA 2½ blasting standard, hot-dip galvanizing, or three-coat epoxy paint system). These measures directly affect the lifespan of the steel structure.





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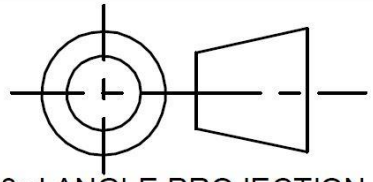
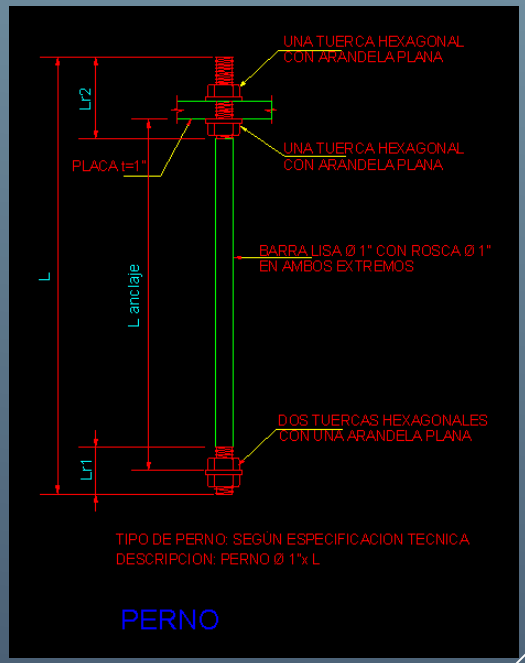
- **General Tolerances:** Acceptable limits for dimensional deviations, particularly in length, plumbness, and alignment.
- **Anchor Bolts:** Placement tolerances (e.g., ±3 mm) and torque requirements must be checked carefully to ensure precise alignment and structural stability.

TOLERANCING	SCALE	SIZE
00 = ±0.2 00.0 = ±0.1 00.00 = ±0.05 angular = ± 0°'30	1:1	A4
ALL DIMENSIONS IN MM		
 3rd ANGLE PROJECTION		
DO NOT SCALE		



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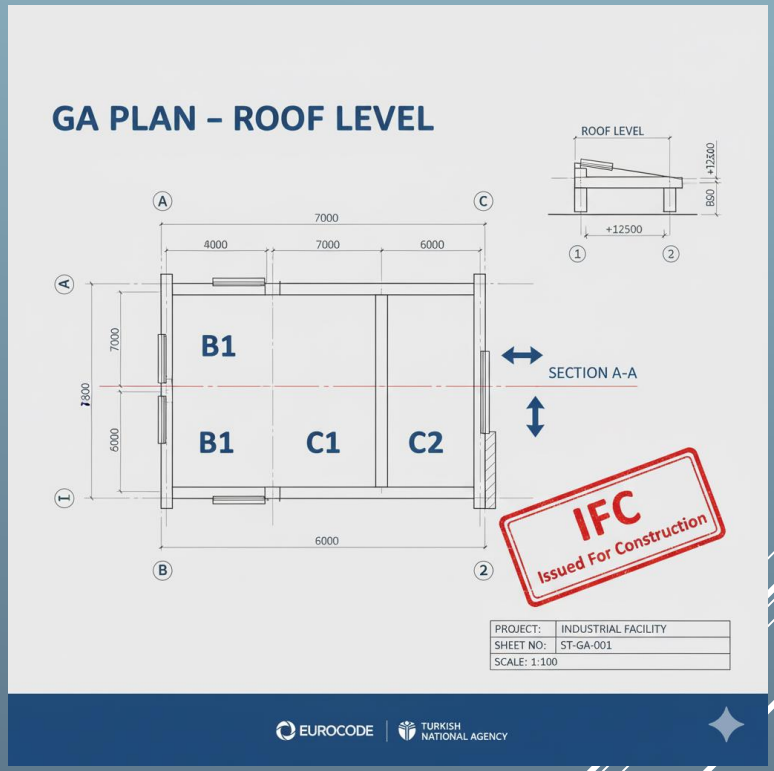
- **Step 3: Examining General Arrangement (GA) Drawings and Grid Lines**
- GA drawings present the **“big picture”** of the project and serve as the starting point for site setup.
- **Technical Explanation:**
  General Arrangement (GA) plans provide the overall layout of structural elements (columns, main beams, bracings), grid lines, floor levels, and primary dimensions. On site, verifying the grid dimensions and elevation codes (levels) at the foundation or substructure stage is the **most critical first step** to ensure the correct positioning of the entire steel structure.
  GA drawings are also used for **coordination between disciplines** (mechanical, electrical, architectural), since they reveal potential clashes between steel members and other systems.



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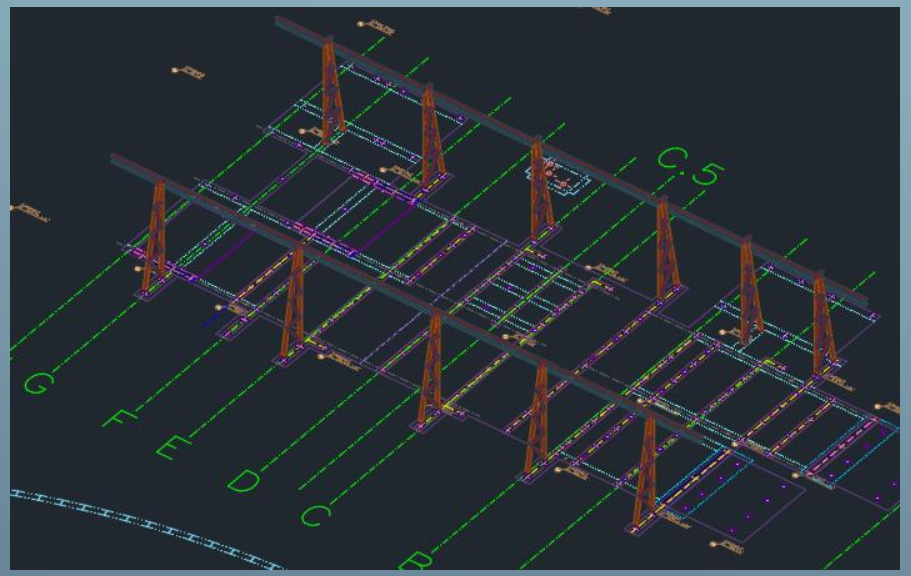
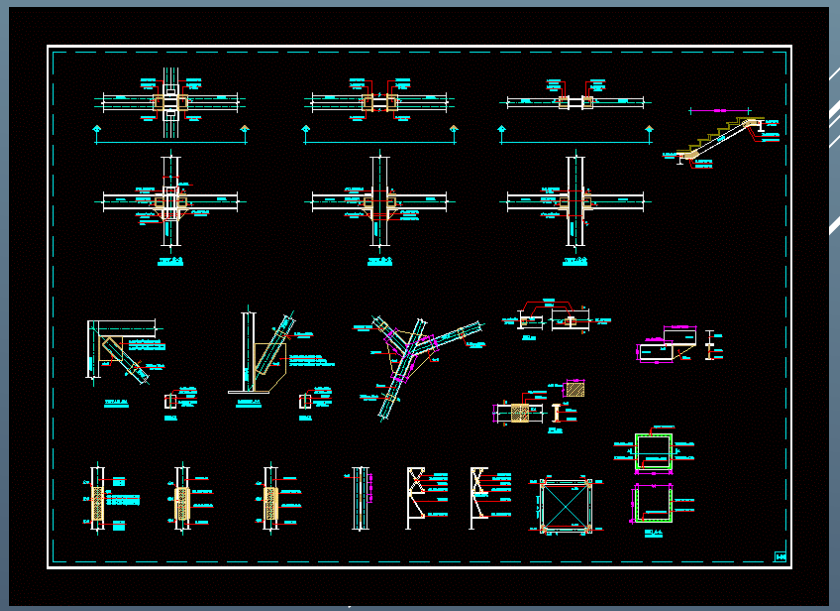
- **Key Points to Pay Attention To:**
- **Grid Lines (A, B, C / 1, 2, 3):**
  All structural elements are referenced to these axes. Correct layout and measurement of grid lines on site are vital. A single mistake in setting out can cause the entire structure to shift.
- **Main Dimensions (Overall Dimensions):**
  Axis spacing and the total width and length of the structure. These are used to check the general structural layout and site positioning.





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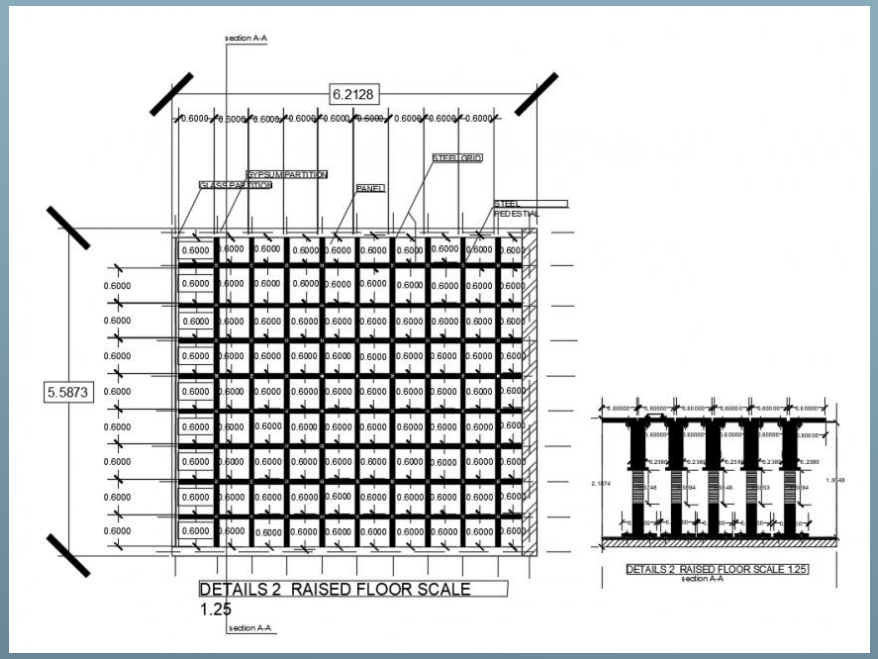
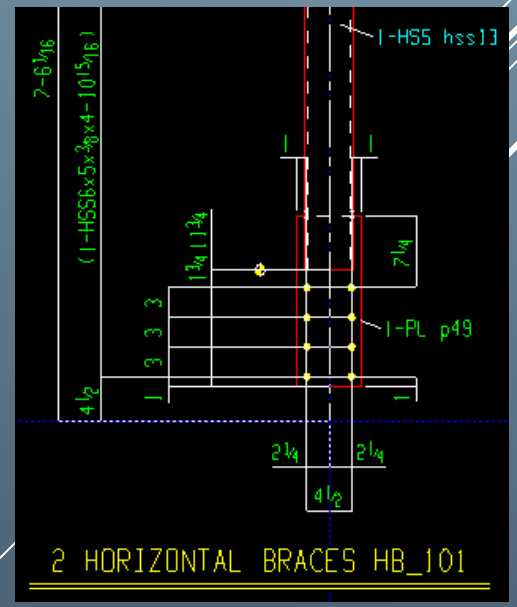
- **Elevation Levels (Floor Levels):**
  Each floor and roof finished level (e.g., +3.500) is indicated. These are the main vertical alignment references.
- **Member Mark Numbers:**
  Unique identifiers for columns (e.g., C1, C2), main beams (e.g., B1, B2), and bracings (e.g., D1, D2). These mark numbers correspond to the erection drawings, showing which element goes where.





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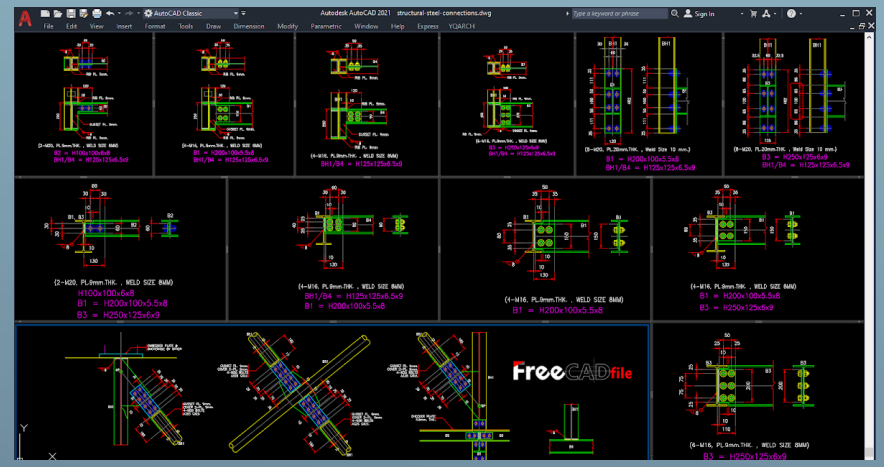
- **Section Lines:**
  In GA drawings, pay attention to section indicators (e.g., Section A-A, B-B), which show where detailed sections are taken. These sections illustrate the vertical relationships between elements.
- **Site Plan (Layout Plan):**
  In large-scale projects, GA drawings may include a site plan showing the structure's position within the overall site and its relation to other buildings or areas.



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Understanding Architectural Projects: The Blueprint of Reality

Buğra Hamzaçebi

Hamzaçebi Architecture

Co-funded by the European Union

Buğra Hamzaçebi
Architect
Hamzaçebi Architecture, Engineering and Construction Industry and Trade Ltd. Co.

The Bridge Between Concept and Construction

- Technical Definition: A comprehensive set of documents and drawings that define the physical characteristics of a building.
- Legal Document: Acts as a binding contract between the client, the contractor, and the local authorities.
- Communication Tool: Translates an abstract design idea into a technical language that engineers, contractors, and craftsmen can understand.
- Graphical Language: Uses standardized symbols, lines, and scales to represent 3D reality on a 2D plane

Why Do We "Read" Projects?

- Implementation: To guide the construction process with precision on-site.
- Permitting: To obtain necessary legal building permits from municipalities and government agencies.
- Cost Estimation: To provide a basis for quantity surveying and detailed budget planning.
- Technical Coordination: To ensure the architectural design is compatible with structural, mechanical, and electrical engineering systems.
- Quality Control: To verify that the final construction matches the approved design standards.

The Design and Technical Team

- Lead Architect: Responsible for the conceptual design, spatial organization, and aesthetic vision.
- CAD Technicians / BIM Modelers: Specialized professionals who translate sketches into digital technical drawings (AutoCAD, Revit, etc.).
- Specialist Consultants: Interior designers, landscape architects, and urban planners who contribute to specific project layers.
- Integrated Process: The architect coordinates with Civil, Mechanical, and Electrical Engineers to ensure a holistic design..

From Drawing Board to Legal Authorization

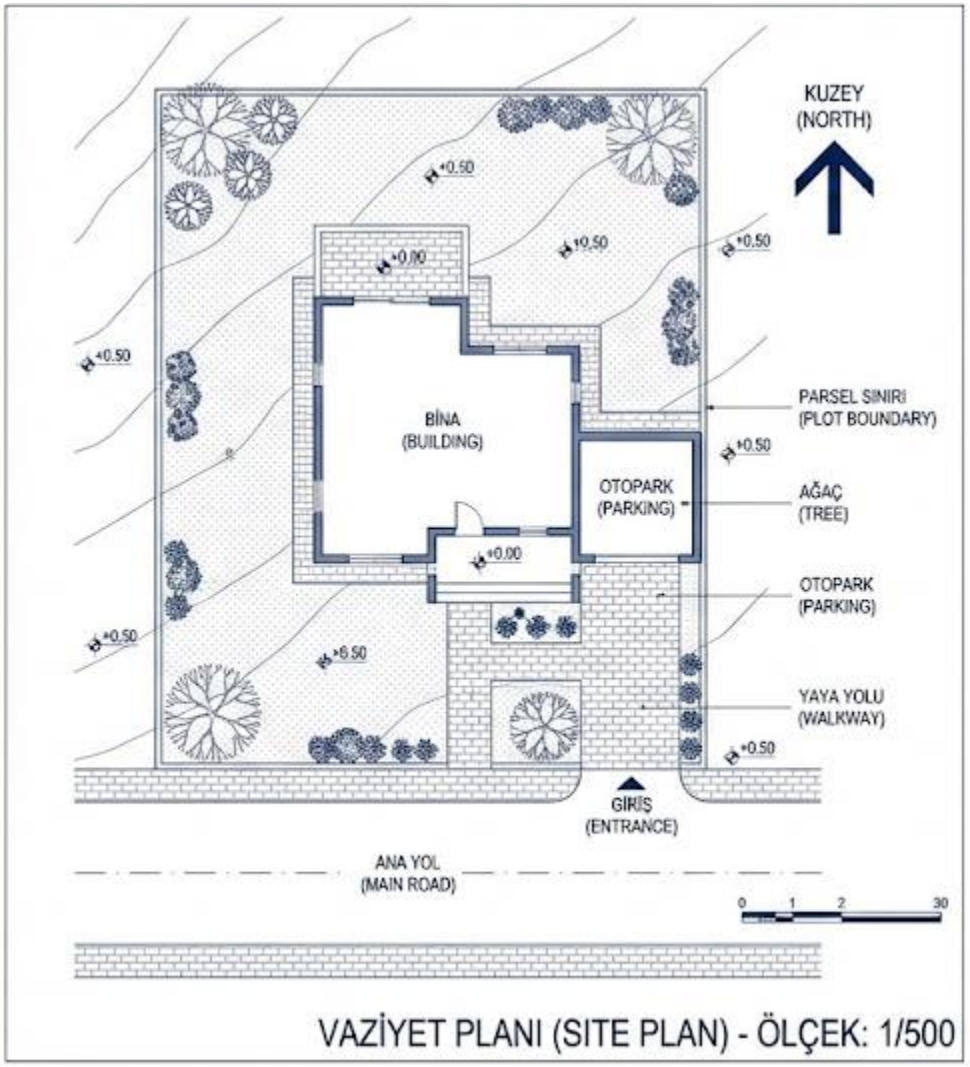
- Preliminary Design: Initial approval from the client for the basic concept.
- Technical Review: Internal checks by senior architects and engineering leads for feasibility.
- Municipality/Local Authority: Formal review for compliance with zoning laws, building codes, and safety regulations.
- Professional Chambers: In many regions (like Türkiye), projects must be registered and stamped by the Chamber of Architects.
- Special Departments: Specific approvals from the Fire Department, Health Authorities, or Environmental Agencies depending on building type.

What Does a Complete Set Include?

- Site Plan: Shows the building's position relative to its environment, plot boundaries, and infrastructure.
- Floor Plans: Detailed 2D "slices" of each level showing rooms, walls, and dimensions.
- Sections: Vertical cuts showing floor heights, structural thickness, and interior layers.
- Elevations: External views of the building from the North, South, East, and West.
- Detail Drawings: Close-up views of specific components like windows, stairs, or roof joints.
- Schedules: Lists of materials, finishes, doors, and windows (Table of quantities).

The Grammar of Drawing

- Standard Scales: Using 1/50 for floor plans, 1/100 or 1/200 for site plans, and 1/5 or 1/10 for details.
- Linework & Symbols: Different line weights (thick vs. thin) represent different materials or distances.
- Annotation: Text notes and dimensions that provide context to the graphics.
- Title Blocks: Standard labels found in the corner of every drawing containing project name, date, and revision numbers.

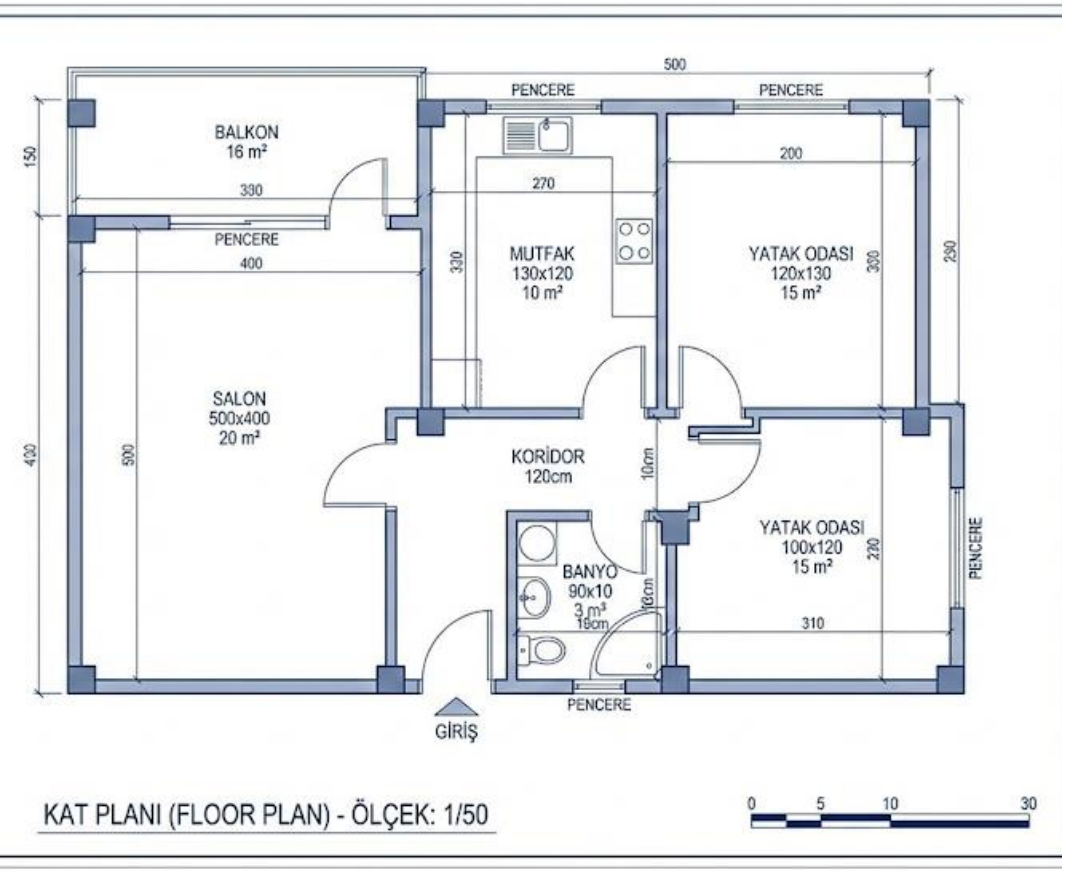


The Big Picture: Building & Environment

- Definition: A "bird's-eye view" showing the exact location and orientation of the proposed building within its property boundaries. It establishes the relationship between the project and its surroundings.

Key Components:

- Plot Boundaries: The legal limits of the land.
- Building Position: The footprint of the structure, including distances to boundaries (setbacks).
- Orientation: A North arrow is vital for understanding sun exposure and wind direction.
- Access: Locations of vehicle entrances, pedestrian walkways, and parking areas.
- Context: Shows adjacent roads, sidewalks, and sometimes neighboring structures or utility connection points.
- Landscaping & Topography: Indications of green areas, trees, and ground levels (elevations).



The Interior Layout: Rooms, Walls, and Precision

- Definition: Floor plans are detailed 2D "slices" taken horizontally through each level of a building, providing a top-down view of the interior layout.

Key Components:

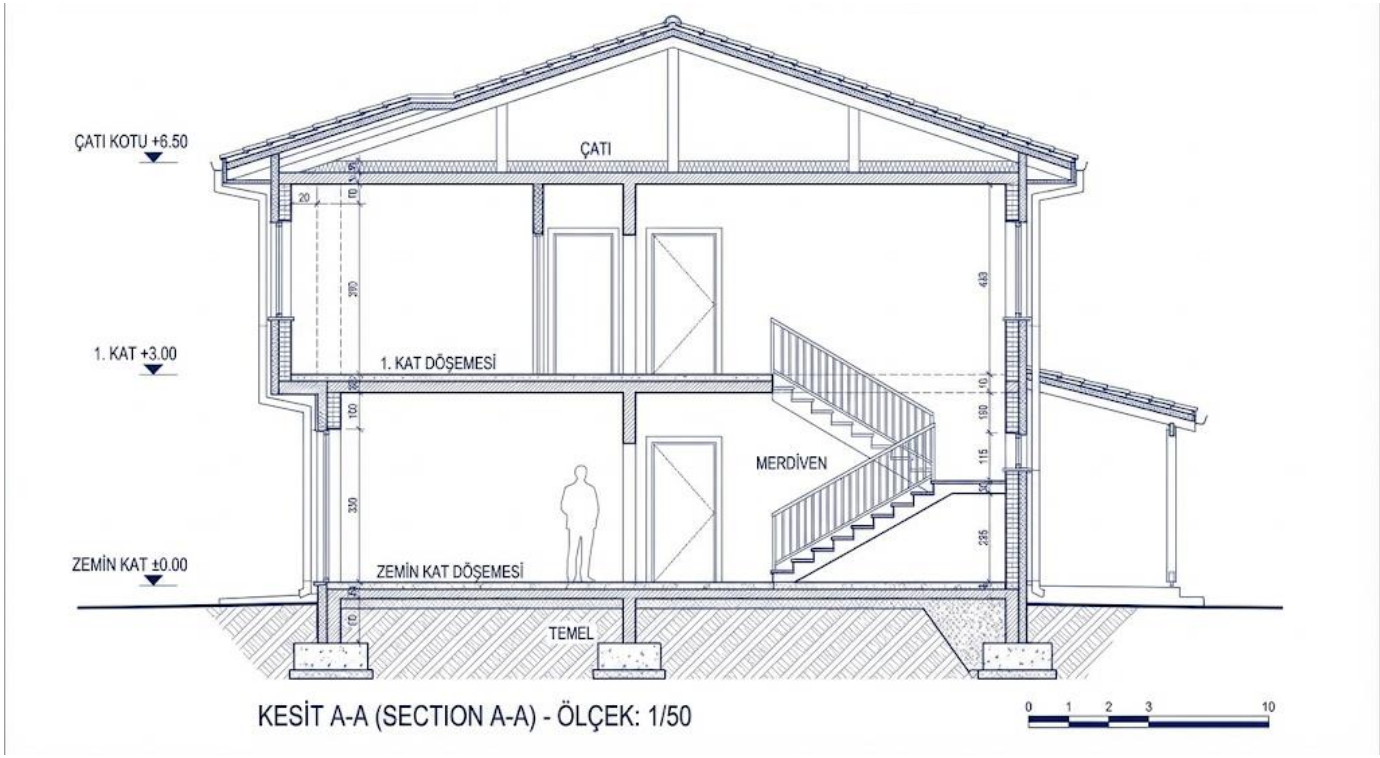
- Spatial Organization: Visualizes the arrangement of rooms, corridors, and functional areas.
- Wall Details: Shows wall thicknesses, materials, and structural elements like columns or load-bearing partitions.
- Dimensions: Provides critical measurements, including room widths, wall lengths, and total building spans.
- Openings: Clearly marks the location, width, and swing direction of all doors and windows.
- Level Indicators: Notes the exact elevation of the floor relative to the project's zero point (e.g., ±0.00).
- Annotations: Includes room names and area calculations in square meters.

The Vertical Dimension: Heights, Structure, and Layers

Definition: A section is a vertical "slice" through a building, like cutting a cake, revealing its internal structure and vertical relationships that are not visible in floor plans.

Key Components:

- Floor Heights: Clearly shows the vertical levels of each floor, roof, and foundation relative to a zero point.
- Structural Elements: Depicts the foundation, floor slabs, beams, and roof trusses, showing their thickness and position.
- Material Layers: Uses different hatching patterns to indicate materials like concrete, brick, insulation, and earth.
- Vertical Circulation: Shows how stairs, elevators, and shafts connect different levels.
- Interior Profile: Reveals the height of rooms, positions of doors and windows in walls, and ceiling shapes.

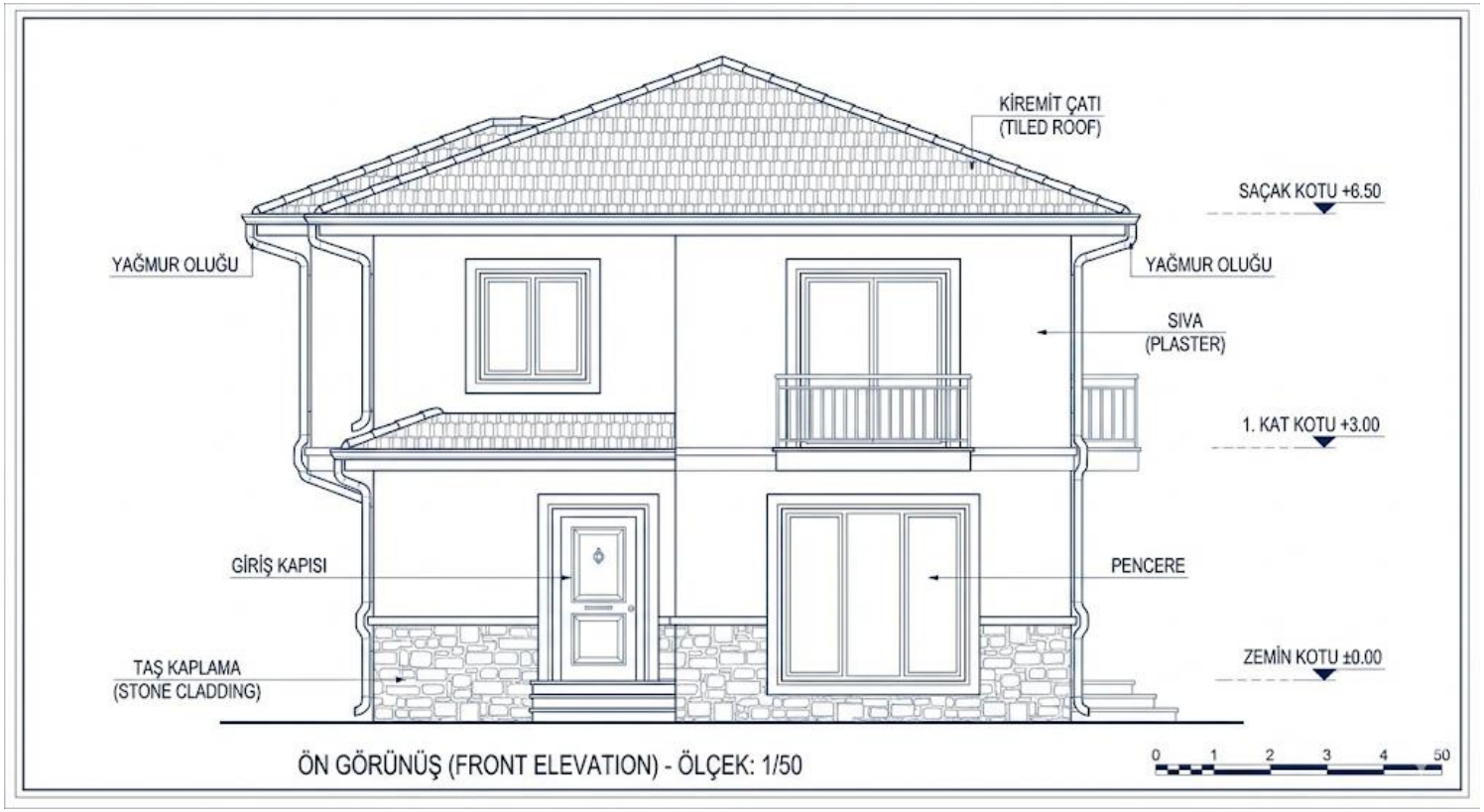


The Exterior View: Facades, Materials, and Character

Definition: Elevations are flat, 2D views of a building's exterior facades, projected onto a vertical plane. They show what the building will look like from the outside from a specific direction (North, South, East, West).

Key Components:

- Exterior Design: Illustrates the architectural style, proportions, and overall aesthetic of the building.
- Materials & Finishes: Specifies exterior materials such as stone, plaster, wood, and roofing materials.
- Openings: Shows the exact design, size, and location of all doors and windows.
- Vertical Dimensions: Provides critical heights for elements like the ground level, floor levels, and roof eaves.
- Roof & Rainwater: Details the roof shape, pitch, gutters, and downspouts.

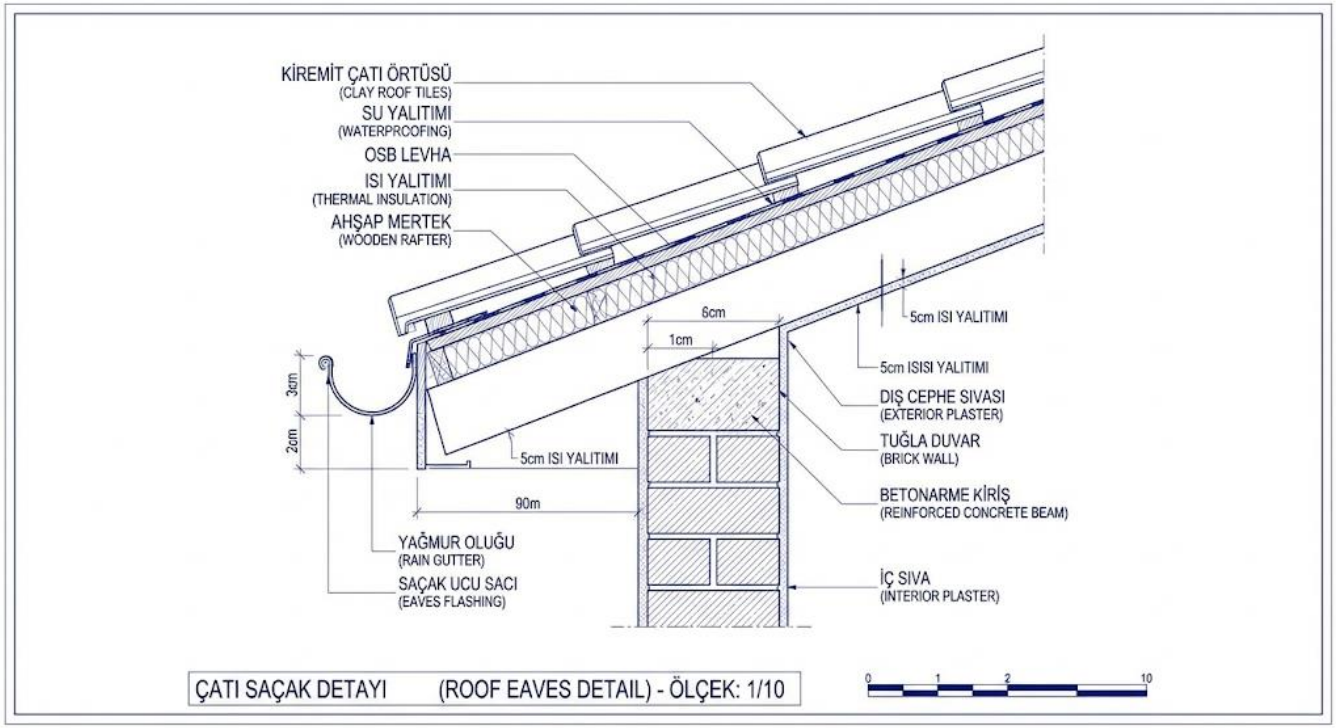


The Microscope of Construction: Zooming in on Critical Junctions

Definition: Detail drawings are large-scale, close-up views of specific, complex parts of a building. They explain how different materials and components come together to form a functional and secure assembly.

Key Components:

- Large Scale: Drawn at scales like 1/5, 1/10, or 1/20 to show small elements clearly.
- Material Layers: Explicitly identifies every layer, such as waterproofing, thermal insulation, structure, and finishes.
- Connections: Shows how elements are fastened or joined, like the connection between a roof and a wall.
- Specific Dimensions: Provides precise measurements for material thicknesses, overlaps, and gaps that are too small to show on general plans.
- Critical Areas: Focuses on complex points like roof eaves, window installations, stair treads, or foundation-to-wall joints where construction errors are most likely to occur.



Data & Quantities: Organizing Project Information

Definition: Schedules are systematic lists or tables that provide detailed information about specific building components, materials, or finishes. They complement the drawings by organizing complex data in an easy-to-read format.

Key Components:

- Door & Window Schedules: Lists every door and window, specifying types, dimensions, materials, and hardware.
- Finish Schedules: Defines materials for floors, walls, and ceilings in every room.
- Quantity Surveying: Provides data for calculating total material amounts for cost estimation.
- Specifications: Includes technical details like glass types or fire ratings.
- Coordination: Ensures correct ordering and installation of products

KAPI VE PENCERE LİSTESİ
(DOOR & WINDOW SCHEDULE)

TİP NO. (TYPE NO.)	KONUM (LOCATION)	ADET (QTY)	GENİŞLİK (WIDTH cm)	YÜKSEKLİK (HEIGHT cm)	MALZEME (MATERIAL)	AÇIKLAMA (DESCRIPTION)
K1 (Door)	Zemin Kat / Salon (G. Floor / Living)	1	90	210	Ahşap Panel (Wood Panel)	Boyalı, 3 Menteşeli (Painted, 3 Hinges)
K2 (Door)	Zemin Kat / Salon (G. Floor / Living)	1	90	210	Ahşap Panel (Wood Panel)	Boyalı, 3 Menteşeli (Painted, 3 Hinges)
K3 (Door)	Zemin Kat / Salon (G. Floor / Living)	1	90	210	Ahşap Panel (Wood Panel)	Boyalı, 3 Menteşeli (Painted, 3 Hinges)
K4 (Door)	Zemin Kat / Salon (G. Floor / Living)	1	90	210	Ahşap Panel (Wood Panel)	Boyalı, 3 Menteşeli (Painted, 3 Hinges)
K5 (Door)	Zemin Kat / Salon (G. Floor / Living)	1	90	210	Ahşap Panel (Wood Panel)	Boyalı, 3 Menteşeli (Painted, 3 Hinges)
P1 (Window)	Zemin Kat / Mutfak (G. Floor / Kitchen)	2	120	100	PVC, Çift Cam (PVC, D. Glazed)	Beyaz, Isı Yalıtımlı (White, Insulated)
P1 (Window)	Zemin Kat / Mutfak (G. Floor / Kitchen)	2	120	100	PVC, Çift Cam (PVC, D. Glazed)	Beyaz, Isı Yalıtımlı (White, Insulated)
P1 (Window)	Zemin Kat / Mutfak (G. Floor / Kitchen)	2	120	100	PVC, Çift Cam (PVC, D. Glazed)	Beyaz, Isı Yalıtımlı (White, Insulated)
P1 (Window)	Zemin Kat / Mutfak (G. Floor / Kitchen)	2	120	100	PVC, Çift Cam (PVC, D. Glazed)	Beyaz, Isı Yalıtımlı (White, Insulated)
P1 (Window)	Zemin Kat / Mutfak (G. Floor / Kitchen)	2	120	100	PVC, Çift Cam (PVC, D. Glazed)	Beyaz, Isı Yalıtımlı (White, Insulated)

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Water supply system problems: mistakes, consequences, and solutions

Expert Dmitry Mamaev
Conres Statyba, UAB

Co-funded by the European Union

Dmitry Mamaev
Conres Statyba, UAB
Construction Project Manager

An experienced Construction Project Manager with hands-on expertise in residential and administrative building development in Lithuania and France. In-depth knowledge of design analysis and optimization ensures efficient resource utilization and the highest quality standards. Expert competence enables seamless coordination of projects with governmental institutions, ensuring timely and smooth construction processes. Strong leadership and strategic planning skills guarantee effective team management and project success.

WATER SUPPLY SYSTEM PROBLEMS: MISTAKES, CONSEQUENCES, AND SOLUTIONS

- WATER SUPPLY SYSTEMS ARE AN ESSENTİAL PART OF ANY BUİLDİNG OR İNFRASTRUCTURE, ENSURİNG A CONTİNUOUS WATER SUPPLY TO USERS. HOWEVER, İMPROPER DESİGN, İNSTALLATİON, OR OPERATİON CAN LEAD TO VARİOUS PROBLEMS – FROM WATER SHORTAGES AND PRESSURE FLUCTUATİONS TO HİGH OPERATİONAL COSTS AND EVEN HEALTH RİSKS.
- COMMON MİSTAKES İNCLUDE İMPROPER PİPE DİAMETER SELECTİON, UNEVEN PRESSURE DİSTRİBUTİON, POORLY PLANNED BRANCH LİNE LENGTHS, AND İNEFFİCİENT CİRCULATİON. SUCH İSSUES CAN CAUSE WATER STAGNATİON, İNCREASE THE RİSK OF BACTERİAL GROWTH, DİSRUPT PUMP OPERATİON, AND REQUİRE ADDİTİONAL İNVESTMENTS İN İNFRASTRUCTURE MODERNİZATİON.
- A WELL-PLANNED AND İNSTALLED WATER SUPPLY SYSTEM NOT ONLY ENSURES SMOOTH WATER DELİVERY BUT ALSO REDUCES LONG-TERM OPERATİONAL COSTS, CONTRİBUTİNG TO SYSTEM LONGEVİTY AND USER COMFORT.

THE PRESENTATION EXAMINES DESIGN, INSTALLATION, AND OPERATIONAL MISTAKES, THEIR CONSEQUENCES, AND POSSIBLE SOLUTIONS.

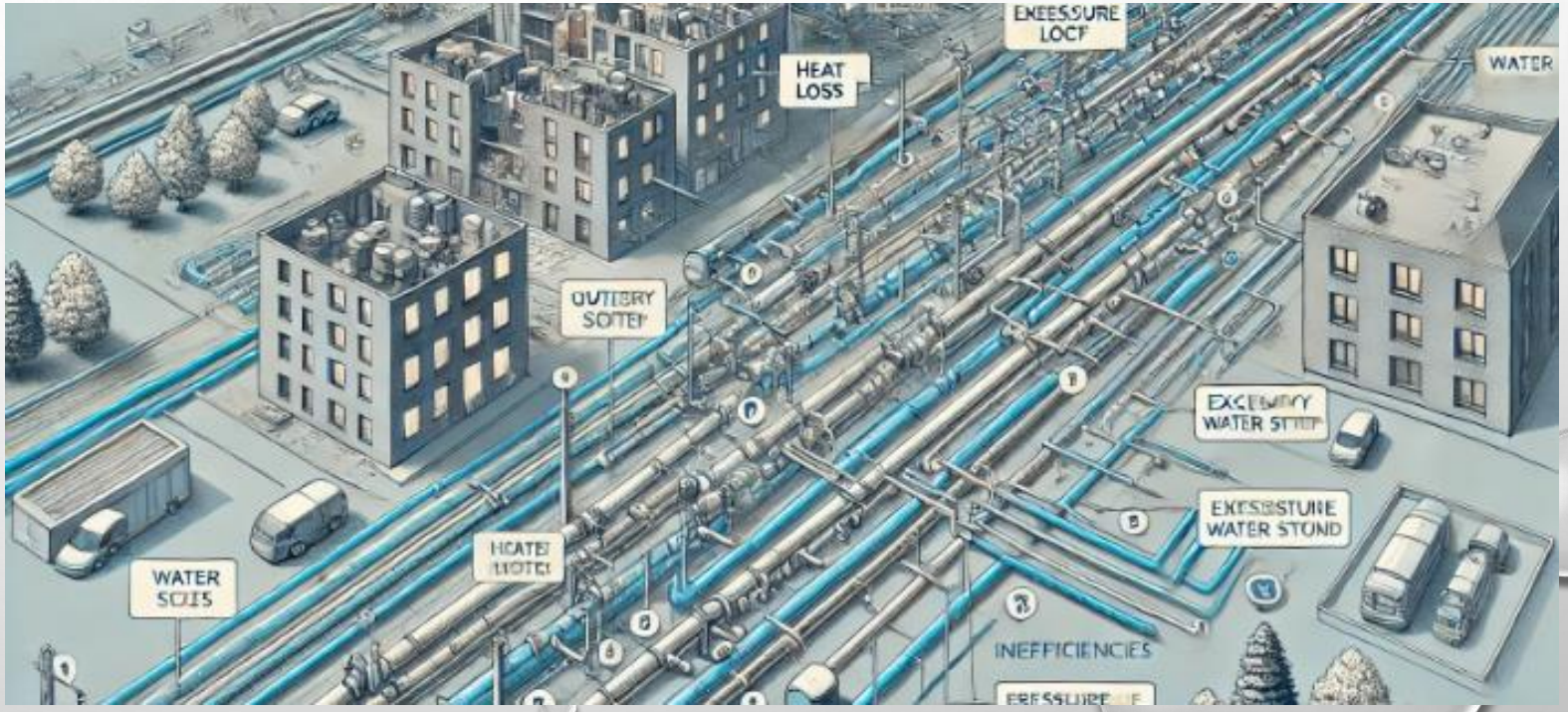
DESIGN MISTAKES

İ. DESIGN MISTAKES:

1. EXCESSIVE DISTANCE FROM WATER SOURCE

CONSEQUENCES:

1. DECREASE İN WATER PRESSURE
2. DETERİORATİON OF WATER QUALİTY
3. LONGER WATER DELİVERY TİME
4. HİGHER ENERGY CONSUMPTİON
5. MORE COMPLEX MAİNTENANCE AND REPAİR WORK



I. DESIGN MISTAKES:

1. EXCESSIVE DISTANCE FROM WATER SOURCE

PROBLEM-SOLVİNG METHODS

1. INCREASİNG WATER PRESSURE

Install pressure boosters, use hydrofor systems.

2. USE OF WATER CIRCULATION SYSTEMS

Install a circulation pump.

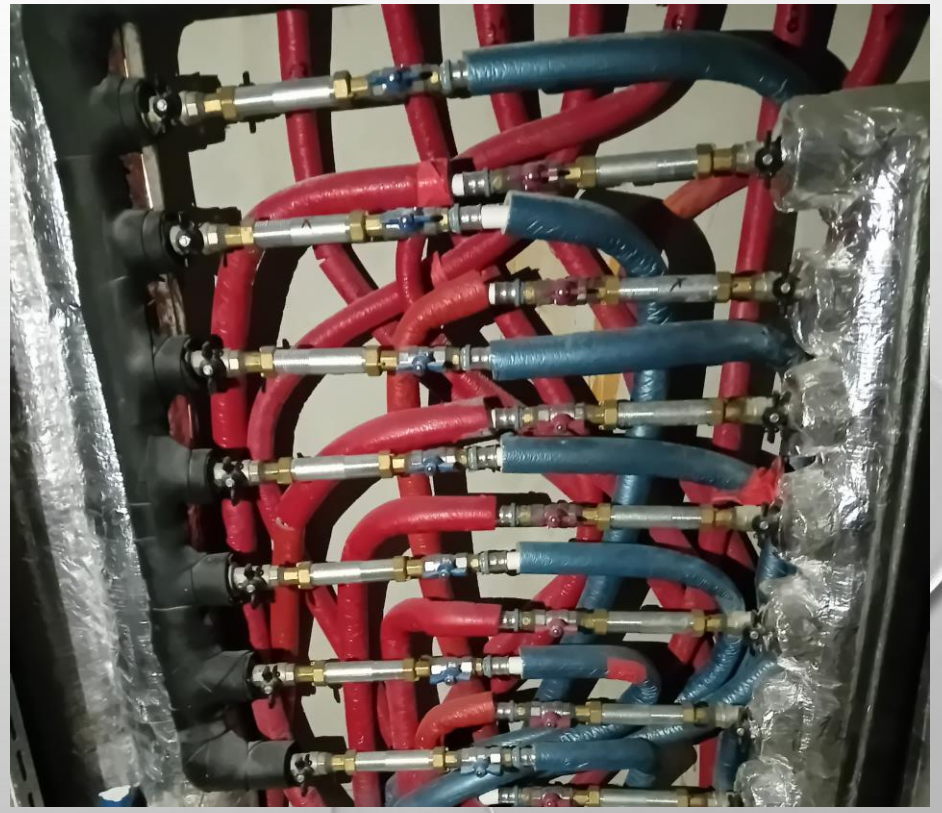
I. DESIGN MISTAKES:

1. EXCESSIVE DISTANCE FROM WATER SOURCE

PROBLEM-SOLVİNG METHODS

3. INSTALLATION OF PRESSURE REGULATORS

4. CORRECT PIPE DIAMETER SELECTION, PIPE ROUTE OPTIMIZATION

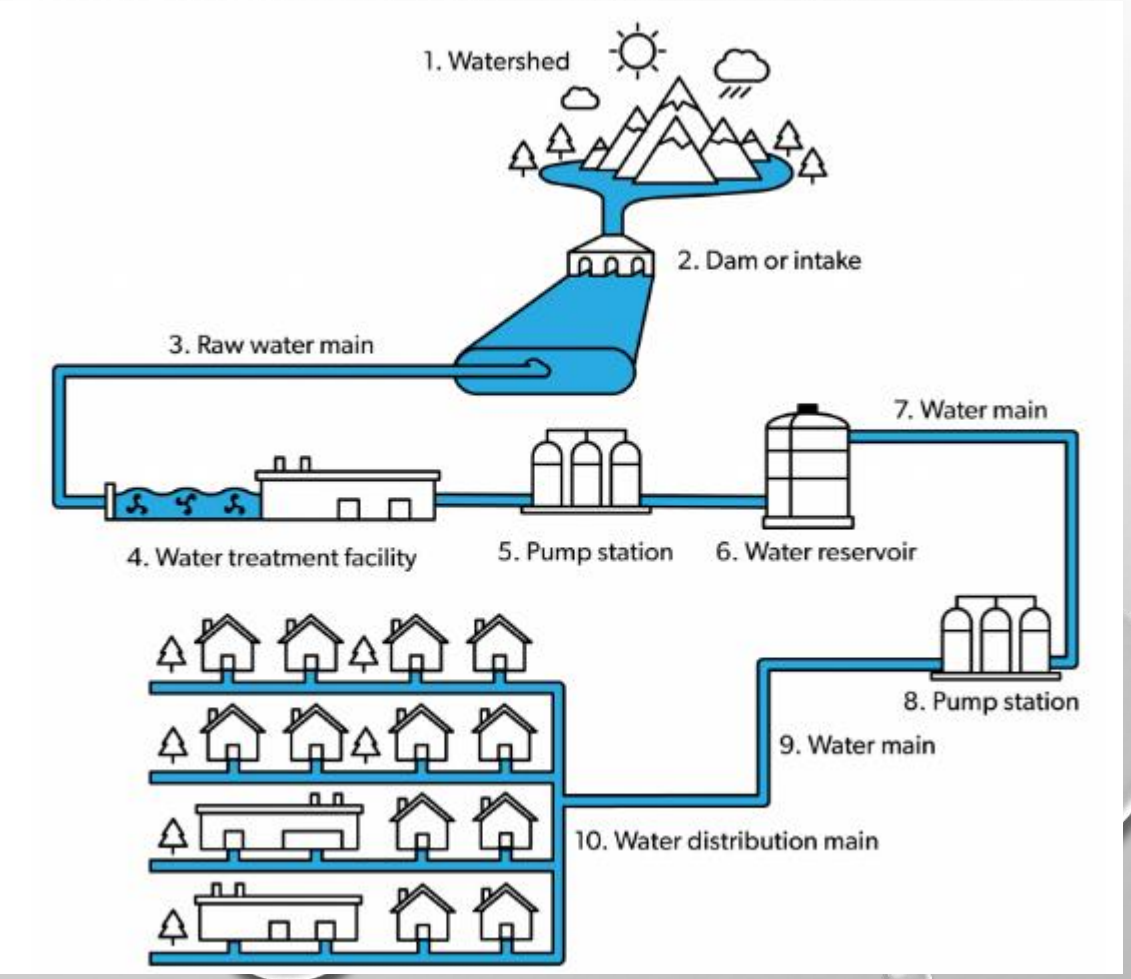


İ. DESIGN MISTAKES:

2. IMPROPERLY ARRANGED MAIN AND BRANCH LINES, POOR WATER DISTRIBUTION

CONSEQUENCES:

1. UNEVEN WATER PRESSURE
2. INSUFFICIENT WATER SUPPLY
3. OVERLY LONG PIPELINES, TOO MANY JOINTS AND ELBOWS, IMPROPERLY PLACED WATER SUPPLY POINTS
4. SIGNIFICANT PRESSURE LOSSES
5. HIGHER OPERATIONAL COSTS
6. HYDRAULIC SHOCKS AND PIPELINE DAMAGE



İ. DESIGN MISTAKES:

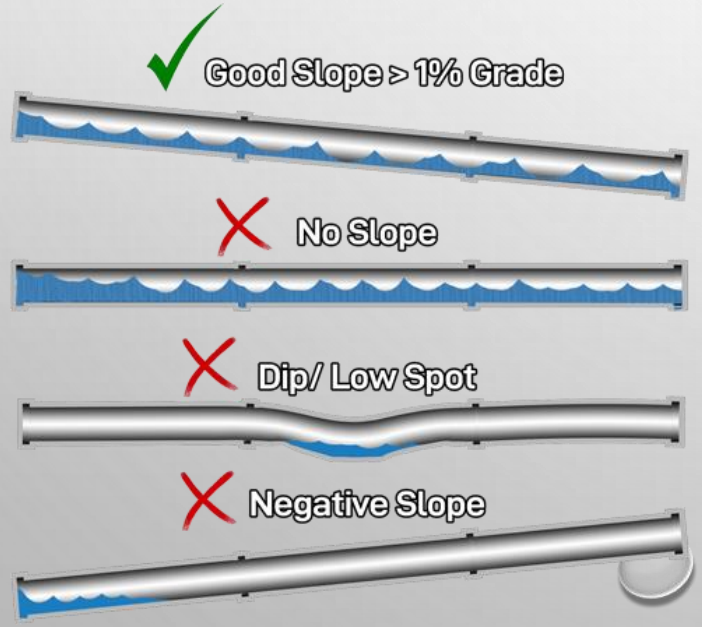
2. IMPROPERLY ARRANGED MAIN AND BRANCH LINES, POOR WATER DISTRIBUTION

PROBLEM-SOLVING METHODS

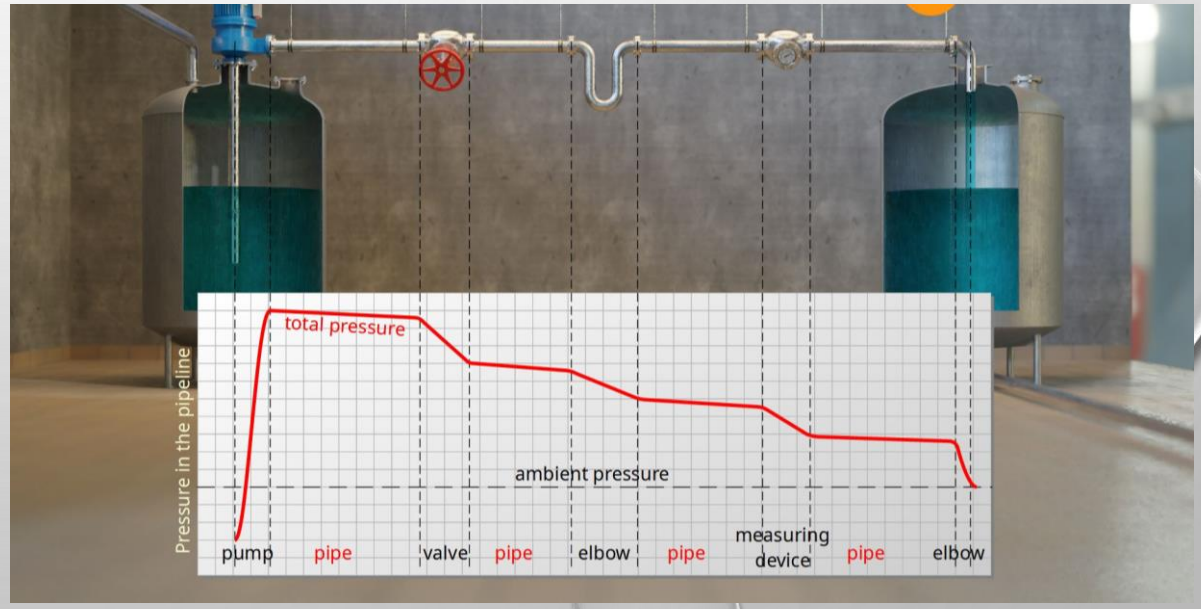
1. USE HYDRAULIC CALCULATIONS TO ENSURE OPTIMAL PRESSURE DISTRIBUTION

Hydraulic calculations allow selecting appropriate pipe diameters and configurations to ensure sufficient pressure for all users. If calculations are not performed, excessive pressure may occur in certain areas (which can damage equipment) or insufficient pressure may hinder normal water supply

2. ENSURING PROPER PIPELINE SLOPE



3. AVOID OVERLY LONG BRANCH LINES, REDUCE THE NUMBER OF PIPE CONNECTIONS AND ELBOWS TO MINIMIZE PRESSURE DROP

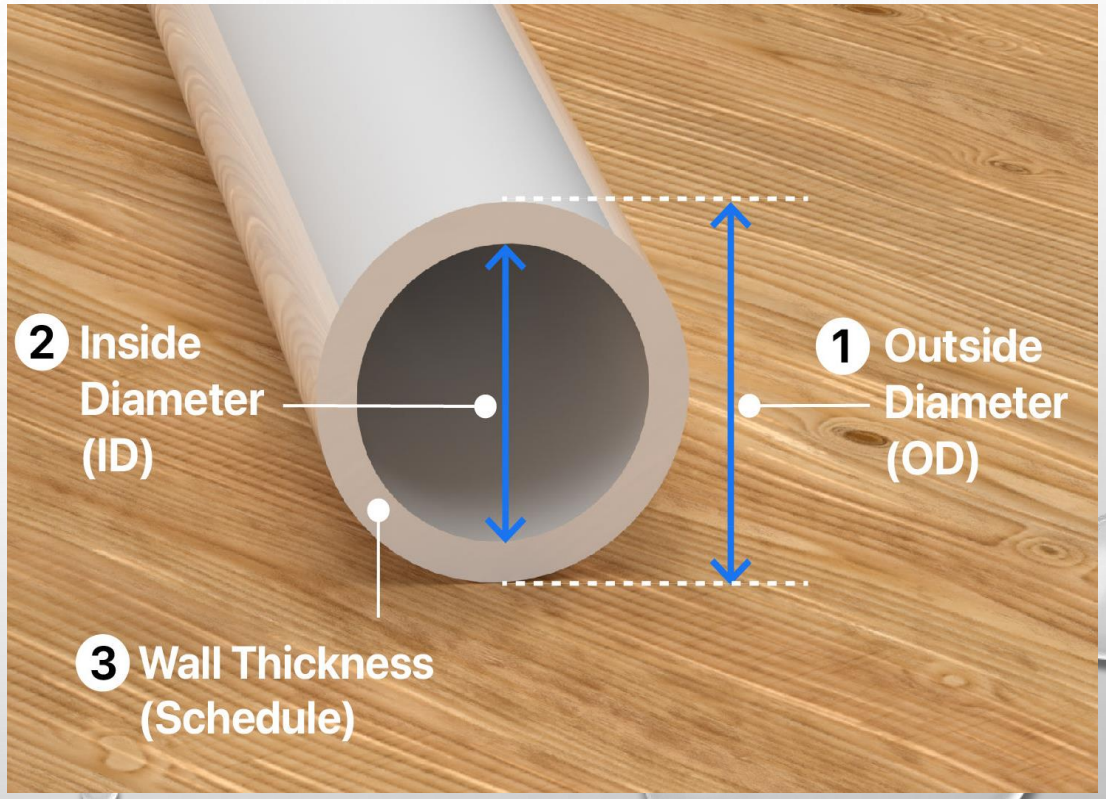


İ. DESIGN MISTAKES:

3. INCORRECT PIPE DIAMETER SELECTION

CONSEQUENCES:

1. DROP IN WATER PRESSURE, ESPECIALLY AT DISTANT POINTS
2. SLOW WATER FLOW, INEFFICIENT SYSTEM PERFORMANCE
3. INCREASING PUMP OPERATING COSTS
4. HIGHER RISK OF PIPE CLOGGING
5. WATER STAGNATION, INCREASED RISK OF BACTERIAL GROWTH
6. HIGHER INSTALLATION COSTS
7. PRESSURE FLUCTUATIONS CAUSING WATER SHORTAGES IN SOME AREAS



I. DESIGN MISTAKES:

3. INCORRECT PIPE DIAMETER SELECTION

PROBLEM-SOLVİNG METHODS

1. PRECISE HYDRAULIC CALCULATIONS, OPTIMAL PIPE DIAMETER SELECTION

- Conduct water demand analysis
- Use specialized hydraulic calculation software
- Select pipe size based on actual water consumption.
- Use different pipe diameters in different network sections.
- Divide the water supply network into separate zones.
- Follow local design standards and regulations.

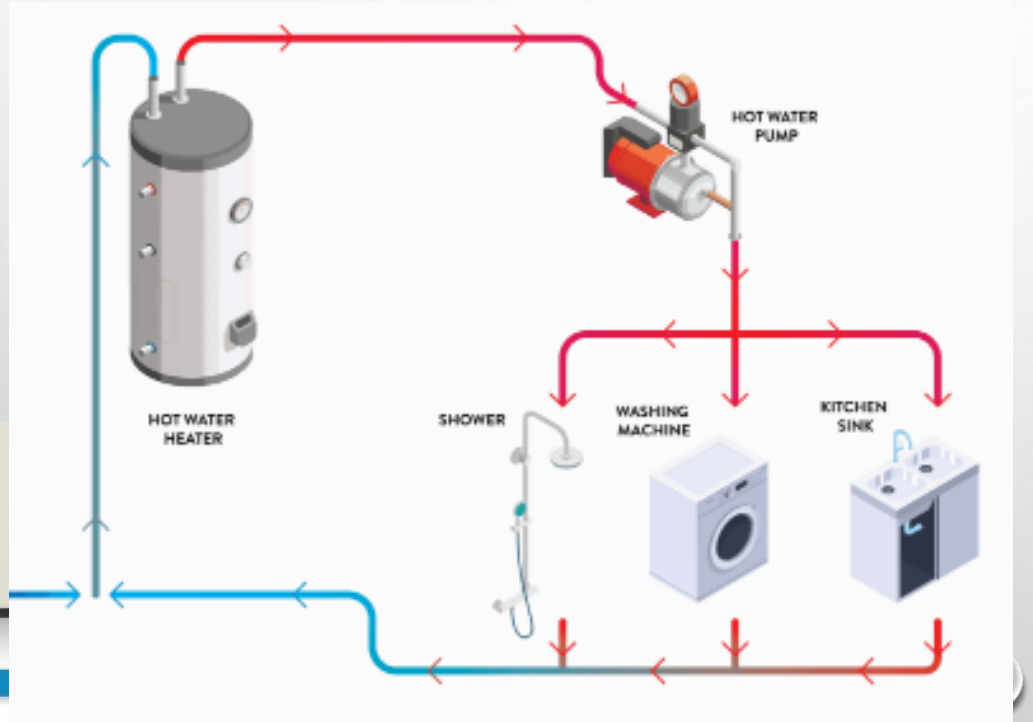
2. USE OF ALTERNATIVE PIPE TYPES

I. DESIGN MISTAKES:

3. INCORRECT PIPE DIAMETER SELECTION

PROBLEM-SOLVİNG METHODS

3. IMPROVING WATER CIRCULATION



4. PERIODIC MAINTENANCE AND DISINFECTION

- Regularly flush pipelines.
- Use chemical or thermal disinfection methods.
- Periodically conduct technical audits and upgrade components if necessary. This will help prevent long-term operational issues and reduce energy consumption.

İ. DESIGN MISTAKES:

4. INCORRECTLY CALCULATED WATER DEMAND

CONSEQUENCES:

1. WATER SHORTAGES DURING PEAK HOURS (MORNING, EVENING).
2. UNSTABLE PRESSURE, ESPECIALLY AT DISTANT POINTS.
3. EXCESSIVE PUMP LOAD AND FREQUENT FAILURES.
4. LARGE INVESTMENTS IN INFRASTRUCTURE.
5. WATER STAGNATION, INCREASED RISK OF BACTERIAL GROWTH.
6. HIGHER MAINTENANCE AND OPERATING COSTS.

I. DESIGN MISTAKES:

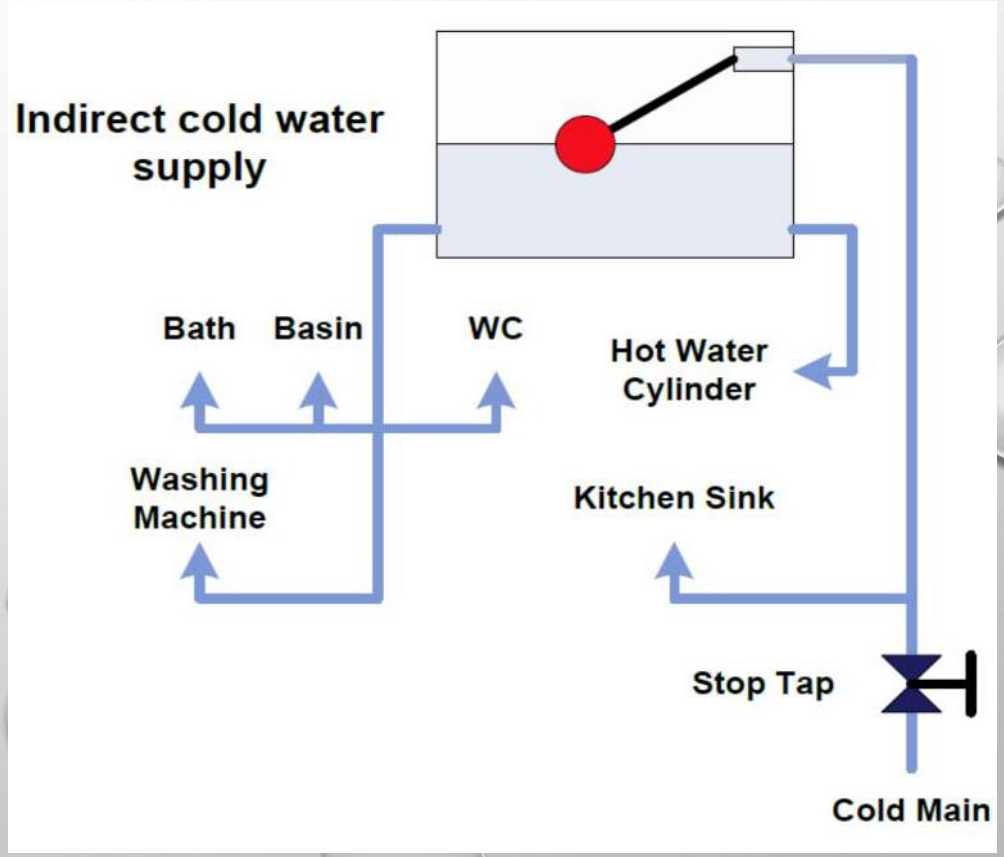
4. INCORRECTLY CALCULATED WATER DEMAND

PROBLEM-SOLVİNG METHODS

1. ACCURATE WATER DEMAND ANALYSIS

- Conduct comprehensive calculations considering: Building type (residential, commercial, industrial), Number of users and their average water consumption, Peak water demand (during peak hours)
- To prevent shortages, a small reserve (10–20%) should be added to the calculated water demand, especially if the system serves large buildings or industrial facilities. However, excessive reserves should be avoided to prevent oversized pipes and stagnation issues.
- Follow local and international construction standards

2. PEAK LOAD MANAGEMENT

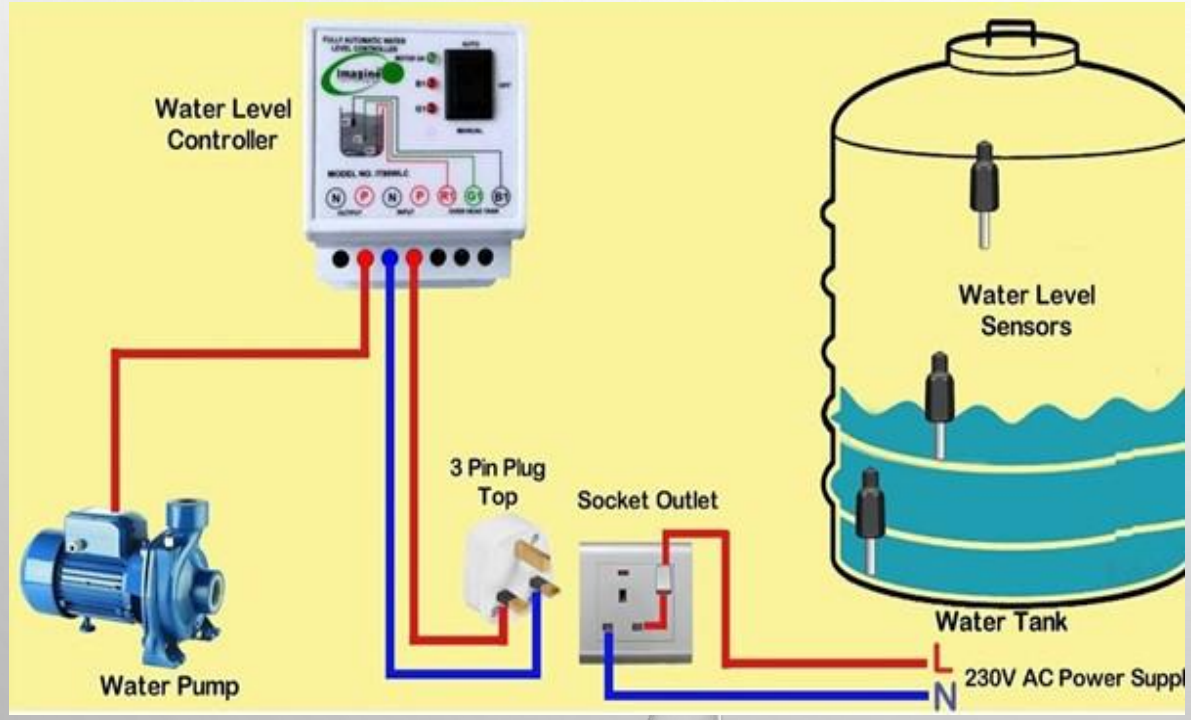


I. DESIGN MISTAKES:

4. INCORRECTLY CALCULATED WATER DEMAND

PROBLEM-SOLVİNG METHODS

3. DYNAMIC FLOW MONITORING SYSTEMS



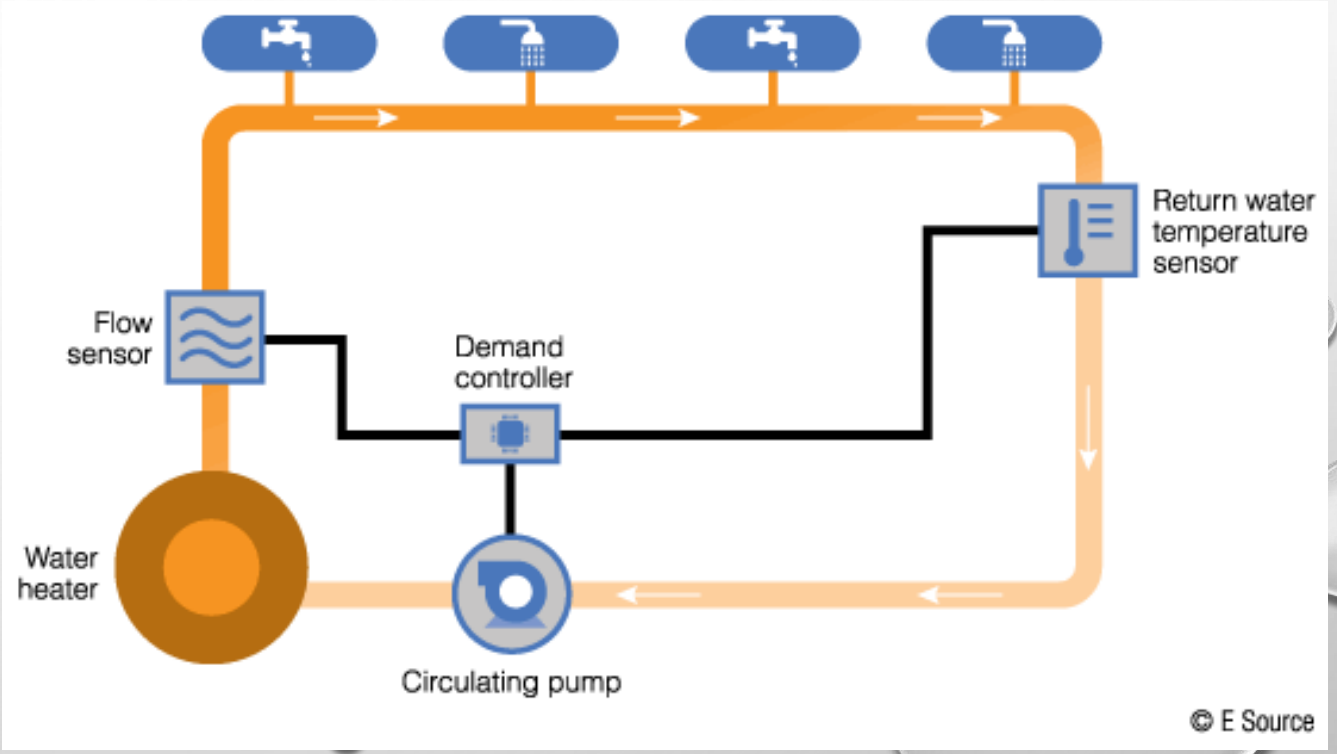
4. INTEGRATION OF ALTERNATIVE WATER SOURCES

İ. DESIGN MISTAKES:

5. INCORRECTLY DESIGNED HOT WATER CIRCULATION NETWORKS

CONSEQUENCES:

1. INEFFICIENT WATER HEATING
2. HIGH HEAT LOSSES
3. UNEVEN WATER TEMPERATURE DISTRIBUTION
4. INCREASED PUMP WORKLOAD
5. RISK OF BACTERIAL GROWTH

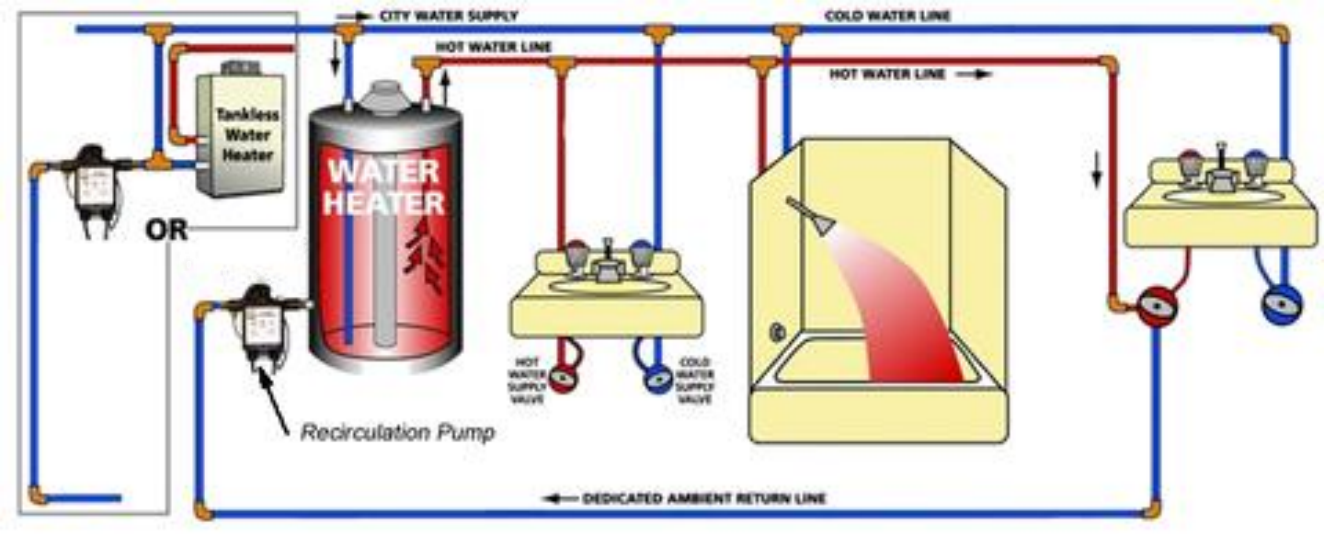


İ. DESIGN MISTAKES:

5. INCORRECTLY DESIGNED HOT WATER CIRCULATION NETWORKS

PROBLEM-SOLVING METHODS

1. PROPER DESIGN OF CIRCULATION SYSTEM



2. PROPER PIPE DIAMETER SELECTION

- If the pipes are too narrow, the pump has to operate at a higher power, increasing energy consumption.
- If the pipes are too wide, the water moves too slowly, which can lead to the risk of Legionella contamination.
- The optimal circulation pipe velocity should be between 0.2 and 0.5 m/s.

3. PREVENTION OF LEGIONELLA

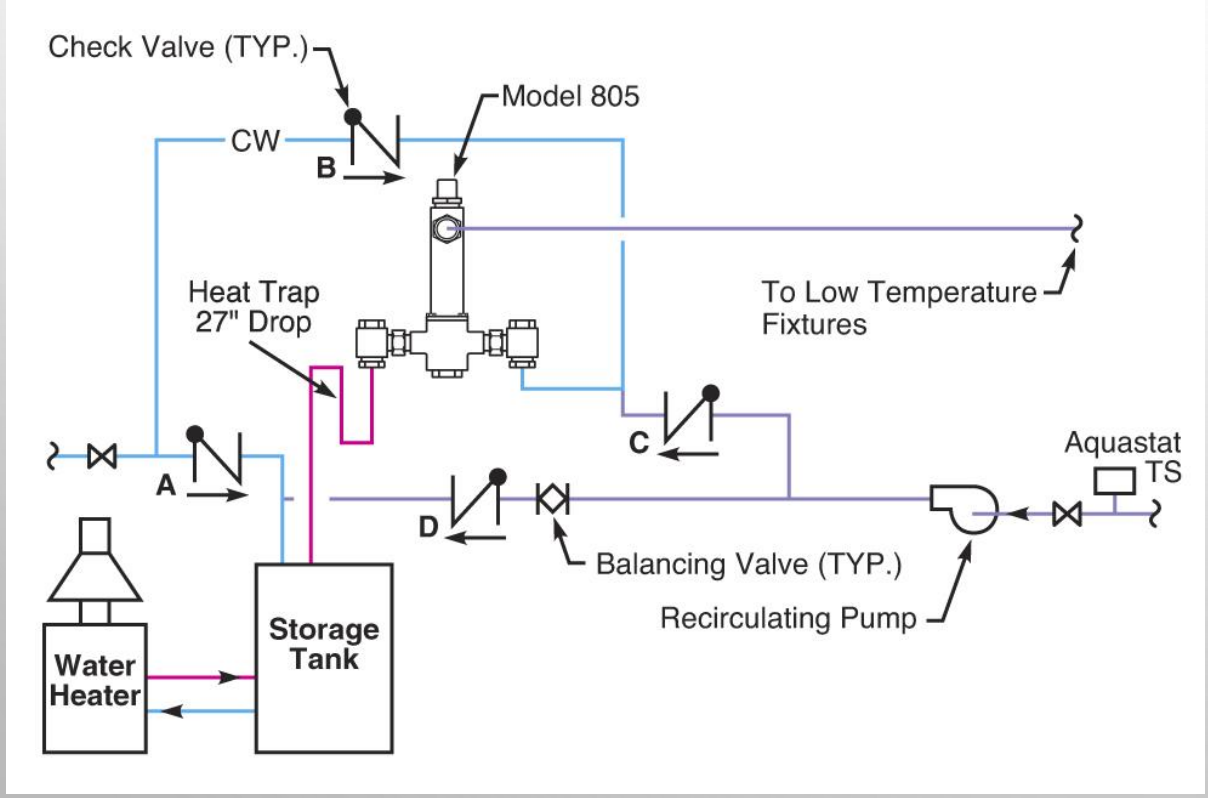
- Ensure that water temperature in the circulation system never falls below 55°C, as this is the critical threshold below which Legionella bacteria multiply.
- Once a month, perform a thermal shock – raise the water temperature to 70°C for a few minutes.

I. DESIGN MISTAKES:

5. INCORRECTLY DESIGNED HOT WATER CIRCULATION NETWORKS

PROBLEM-SOLVİNG METHODS

4. USE OF CIRCULATION PUMPS AND THERMOSTATIC BALANCING VALVES



5. PROPER PIPE INSULATION

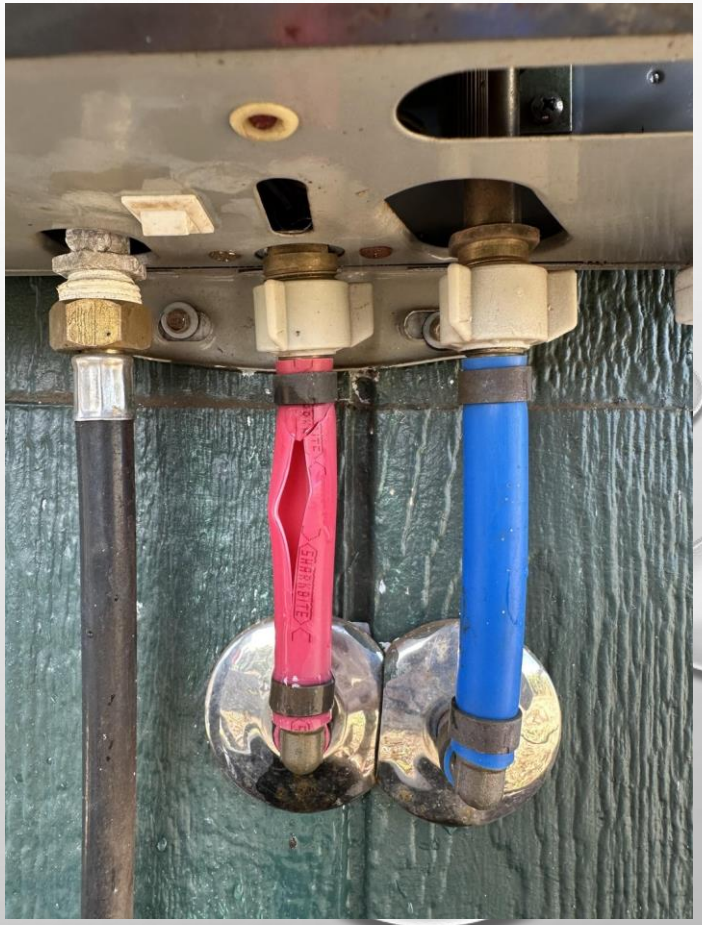
INSTALLATION MISTAKES

İI. INSTALLATION MISTAKES:

1. IMPROPERLY SELECTED PIPES AND CONNECTIONS

CONSEQUENCES:

1. PRESSURE FLUCTUATIONS, INCREASED HYDRAULIC LOSSES, POOR WATER SUPPLY
2. CORROSION, LEAKING JOINTS, REDUCED SYSTEM DURABILITY, WATER LEAKS, AND FAILURES
3. DETERIORATION OF WATER QUALITY, RISK OF BACTERIAL GROWTH



II. INSTALLATION MISTAKES:

1. IMPROPERLY SELECTED PIPES AND CONNECTIONS

PROBLEM-SOLVING METHODS

1. USE OF HIGH-QUALITY AND DURABLE MATERIALS SUITABLE FOR OPERATING CONDITIONS

- Use only certified components that comply with international standards.
- Materials must be suited to the chemical composition of the water.
- If aggressive substances (chlorine, iron, acids) are present, corrosion-resistant materials should be used.
- Pipes for hot water must be resistant to high temperatures.
- It is recommended to avoid black steel, as it may rust and accumulate deposits over time.

Examples: Plastic pipes (PE, PPR, PVC): Corrosion-resistant, lightweight, suitable for indoor systems. **PPR with fiberglass reinforcement:** Resistant to high temperatures. **Copper pipes:** Hygienic and durable but expensive and sensitive to water chemistry. **Stainless steel pipes:** Highly resistant but costly and more complex to install.

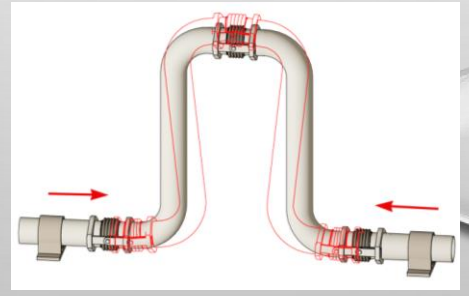
II. INSTALLATION MISTAKES:

1. IMPROPERLY SELECTED PIPES AND CONNECTIONS

PROBLEM-SOLVİNG METHODS

2. CAREFUL INSTALLATION AND SEALING, AVOIDING UNNECESSARY JOINTS AND ANGLES

- The plumbing system should be as straight as possible, avoiding excessive branching of pipes.
- Use specialized connection tools and ensure that joints are properly tightened but not over-tightened.
- Pipe connections must be sealed properly:
  - ✓ **Teflon tape** – for small fittings.
  - ✓ **Sealing pastes** – for larger threaded connections.
  - ✓ **Fiber gaskets** – for pressure assemblies.
- Use expansion compensators for longer pipe sections.
- Perform pipe cleaning and hydraulic testing before commissioning the system.



II. INSTALLATION MISTAKES:

2. POOR PIPE INSULATION

CONSEQUENCES:

1. HEAT LOSS AND INCREASED ENERGY CONSUMPTION
2. CONDENSATION FORMATION AND CORROSION
3. RISK OF FREEZING IN WINTER
4. WATER TEMPERATURE FLUCTUATIONS
5. HIGHER MAINTENANCE AND OPERATIONAL COSTS

II. INSTALLATION MISTAKES:

2. POOR PIPE INSULATION

PROBLEM-SOLVİNG METHODS

1. USE PROPER INSULATION MATERIALS AND CHOOSE THE RIGHT THICKNESS

Examples:

For hot water pipes: Mineral wool with aluminum foil - Resistant to high temperatures and reduces heat loss. Elastomeric foam insulation - Flexible, easy to install, and effectively prevents heat loss.

For cold water pipes: Polyethylene foam insulation - Lightweight, moisture-resistant solution reducing condensation. Polyurethane foam - Excellent freeze protection, often used for outdoor systems.

Recommended insulation thickness:

Hot water pipes: 13–50 mm, depending on diameter and operating conditions.

Cold water pipes: At least 10 mm to prevent condensation.

Outdoor and underground pipes: At least 25–50 mm to protect against cold and moisture.

II. INSTALLATION MISTAKES:

2. POOR PIPE INSULATION

PROBLEM-SOLVİNG METHODS

2. ENSURE PROPER PIPE PLACEMENT AND CONDITIONS

Installation Tips:

- Lay hot water pipes as close as possible to heated areas.
- Protect cold water pipes from humid zones.
- Ensure proper pipe burial when installing outdoors.
- Install under suitable weather conditions, using specialized equipment for winter work.
- Carefully read the manufacturer's recommendations before installing pipes.

II. INSTALLATION MISTAKES:

2. POOR PIPE INSULATION

PROBLEM-SOLVİNG METHODS

3. ENSURE AIRTIGHT AND HIGH-QUALITY INSULATION INSTALLATION

Installation Tips:

- Pipe insulation must be continuous, without gaps or cracks.
- Use vapor barrier films.
- Seal insulation joints with special adhesive tape or sealants.
- If pipes are exposed to mechanical impact, use protective covers or casings.
- Coat metal pipes with anti-corrosion materials before insulation.

II. INSTALLATION MISTAKES:

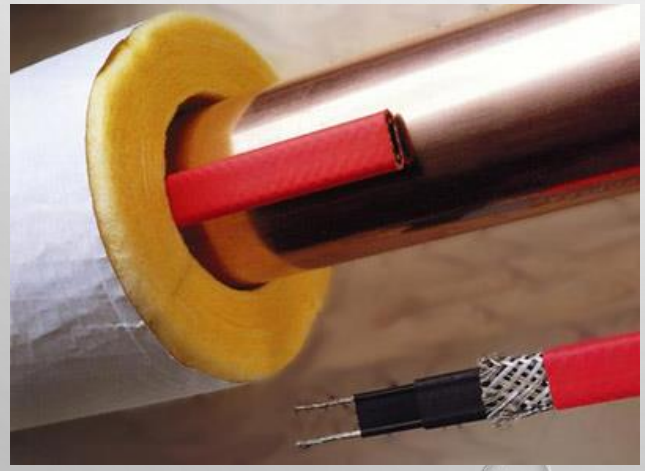
2. POOR PIPE INSULATION

PROBLEM-SOLVİNG METHODS

4. USE HEATING CABLES OR SHUT OFF WATER SUPPLY IN COLD SEASONS

For pipes in unheated spaces or outdoors, electric heating cables can be used.

If pipes are in extremely cold locations and insulation or heating cannot ensure protection, shutting off the water supply in winter when not in use can reduce the risk of freezing.



II. INSTALLATION MISTAKES:

3. IMPROPERLY INSTALLED SHUT-OFF AND CONTROL VALVES

CONSEQUENCES:

1. UNSTABLE PRESSURE AND UNEVEN WATER DISTRIBUTION
2. INCREASED HYDRAULIC LOSSES
3. WATER LEAKS AND HIGHER MAINTENANCE COSTS
4. WATER FLOW NOISE AND VIBRATIONS
5. WATER BACKFLOW AND CONTAMINATION RISK

II. INSTALLATION MISTAKES:

3. IMPROPERLY INSTALLED SHUT-OFF AND CONTROL VALVES

PROBLEM-SOLVİNG METHODS

1. ENSURE PROPER VALVE SELECTION

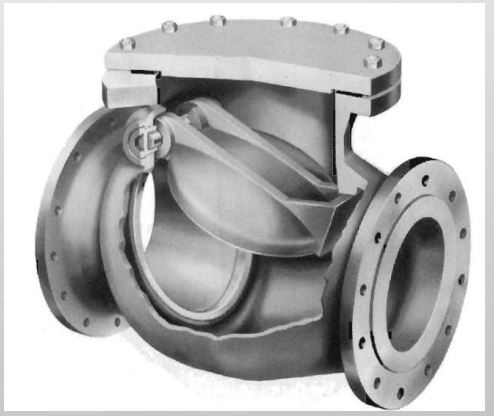
Choose shut-off valves based on pipe diameter, pressure, and expected operational intensity.

Select balancing and control valves using hydraulic calculations to ensure even water distribution.

Use certified valves that meet quality standards.

Examples:

- Ball valves: Suitable for full shut-off and opening but not for flow regulation.
- Butterfly and diaphragm valves: Suitable for precise water flow control.
- Pressure regulators: Needed in systems where water pressure fluctuates.
- Check valves: Prevent contaminated water from re-entering the system.



II. INSTALLATION MISTAKES:

3. IMPROPERLY INSTALLED SHUT-OFF AND CONTROL VALVES

PROBLEM-SOLVİNG METHODS

2. ENSURE PROPER QUANTITY OF PRESSURE REGULATORS

- Select the correct number of regulators.
- Set the optimal pressure.
- Install regulators in the necessary locations.
- Properly perform pressure balancing

Installation Tips:

- Install the main pressure regulator at the inlet.
- In larger houses or buildings, additional regulators may be required for different zones.
- In industrial systems, multiple regulators are needed to accommodate specific zones.

The standard household system pressure is 2.5–3.5 bar. If the pressure exceeds 4 bar, it is recommended to reduce it to prevent damage to pipes and appliances.

II. INSTALLATION MISTAKES:

3. IMPROPERLY INSTALLED SHUT-OFF AND CONTROL VALVES

PROBLEM-SOLVİNG METHODS

3. CORRECT VALVE INSTALLATION

- Install balancing valves in the correct location.
- Install shut-off valves in positions that allow easy operation and maintenance.
- Install valves according to the arrows indicating the flow direction.
- Ensure proper placement of check valves.
- Perform hydraulic tests and adjust the balancing valves.
- Use automatic balancing valves.

Ensure proper **check valve placement**:

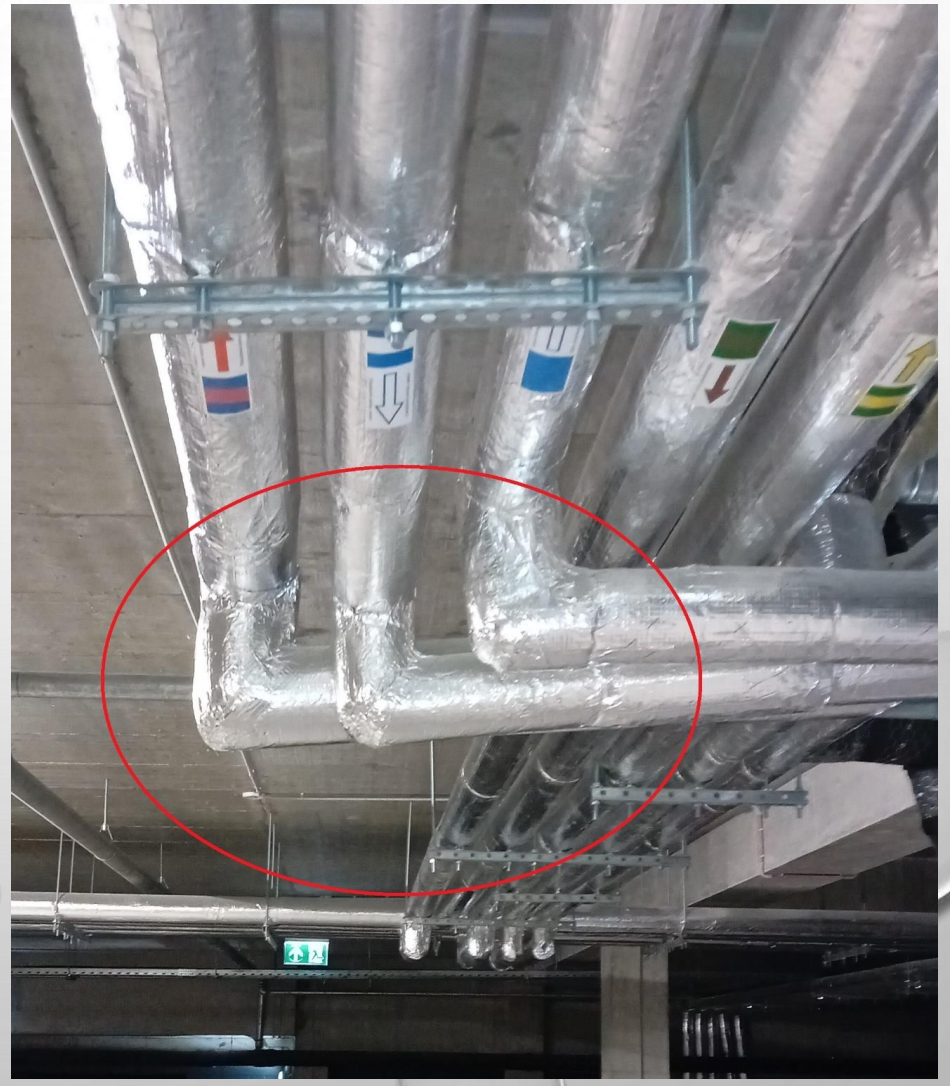
- A check valve before the water meter to protect it.
- A check valve in water heaters to prevent backflow into the cold supply.
- Check valves in pump systems to prevent dry running.

II. INSTALLATION MISTAKES:

4. INSUFFICIENT PIPE SUPPORT

CONSEQUENCES:

1. PIPE VIBRATION AND NOISE
2. PIPE SHIFTS AND DEFORMATIONS
3. INCREASED RISK OF LEAKS
4. INCREASED LOAD ON PUMPS AND VALVES



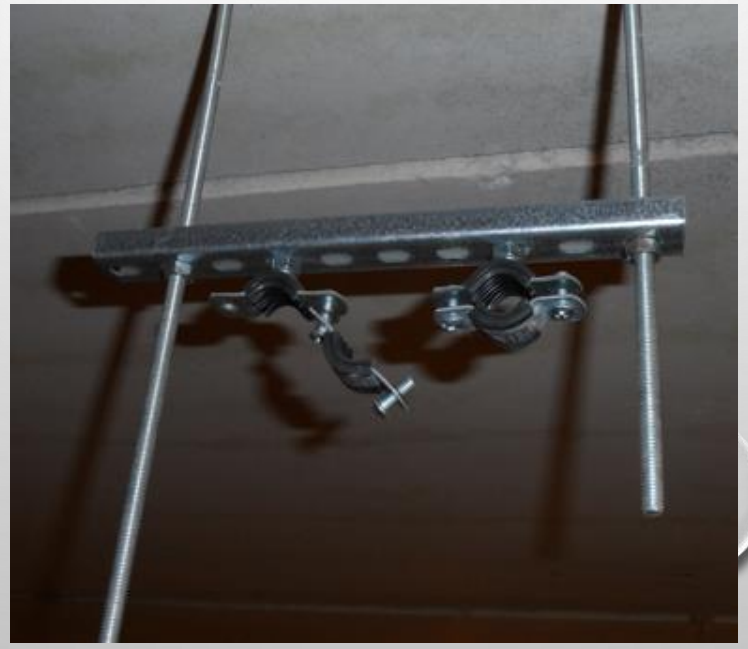
II. INSTALLATION MISTAKES:

4. INSUFFICIENT PIPE SUPPORT

PROBLEM-SOLVİNG METHODS

1. CHOOSING PROPER FASTENING ELEMENTS

- Use appropriately sized and load-bearing brackets, fasteners, clamps, and supports.
- Choose materials that are resistant to corrosion.
- Ensure that fasteners match the pipe diameter and weight.
- Use special brackets with rubber gaskets.
- Install anti-vibration pads between the pipes and supports.



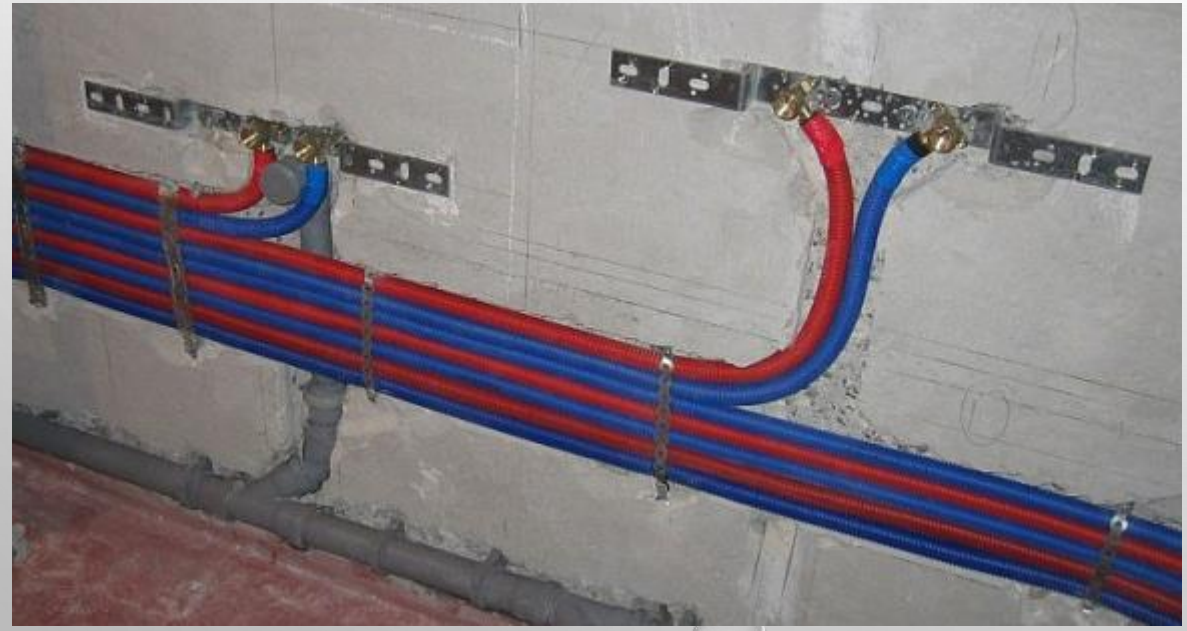
II. INSTALLATION MISTAKES:

4. INSUFFICIENT PIPE SUPPORT

PROBLEM-SOLVİNG METHODS

2. PROPER PLACEMENT OF FASTENING POINTS

- Mount supports according to the pipe diameter and length.
- Properly secure pipes at bends, joints, and areas where pressure or temperature changes occur.
- Coordinate the location of the fasteners with compensating elements.



OPERATIONAL MISTAKES

IIİ. OPERATIONAL MISTAKES:

LACK OF PROPER MAINTENANCE AND TESTING OF THE WATER SUPPLY SYSTEM AFTER INSTALLATION

CONSEQUENCES:

1. UNDETECTED LEAKS AND PRESSURE DROPS
2. HYDRAULIC SHOCKS AND PRESSURE FLUCTUATIONS
3. REDUCED SYSTEM EFFICIENCY AND HIGHER OPERATING COSTS
4. RISK OF WATER CONTAMINATION
5. MORE COMPLEX MAINTENANCE AND HIGHER REPAIR COSTS IN THE FUTURE

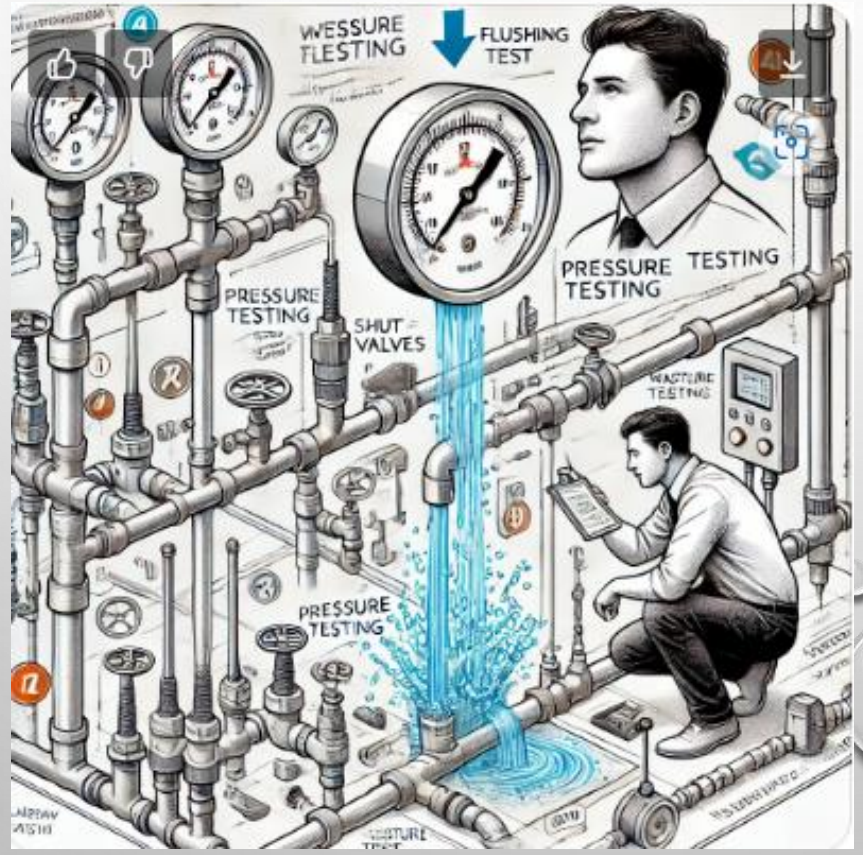
III. OPERATIONAL MISTAKES:

LACK OF PROPER MAINTENANCE AND TESTING OF THE WATER SUPPLY SYSTEM AFTER INSTALLATION

PROBLEM-SOLVİNG METHODS

1. TESTING THE WATER SUPPLY SYSTEM AFTER INSTALLATION

- Pressure Tests
- Flow Balancing Tests
- Hydraulic Shock Analysis



2. WATER QUALITY CONTROL

- Regular Water Testing
- Water Disinfection
- Compliance with Hygiene Standards and Regulations

III. OPERATIONAL MISTAKES:

LACK OF PROPER MAINTENANCE AND TESTING OF THE WATER SUPPLY SYSTEM AFTER INSTALLATION

PROBLEM-SOLVİNG METHODS

3. REGULAR PREVENTIVE MAINTENANCE

- Periodic Pipe and Connection Inspections
- Inspection of Valves, Pumps, and Filter
- Ensuring Protective Systems
- Stocking Spare Parts

CONCLUSION

EFFICIENT WATER SUPPLY SYSTEMS ARE CRUCIAL FOR MAINTAINING THE FUNCTIONALITY, SAFETY, AND COMFORT OF ANY BUILDING OR INFRASTRUCTURE. HOWEVER, DESIGN, INSTALLATION, AND OPERATIONAL MISTAKES CAN LEAD TO SIGNIFICANT INEFFICIENCIES, INCREASED COSTS, AND EVEN HEALTH HAZARDS. BY UNDERSTANDING THE MOST COMMON MISTAKES, WE CAN TAKE PROACTIVE MEASURES TO PREVENT THESE ISSUES. A WELL-OPTIMIZED SYSTEM NOT ONLY ENSURES RELIABLE WATER DISTRIBUTION BUT ALSO ENHANCES LONGEVITY AND SUSTAINABILITY. THIS PRESENTATION HIGHLIGHTS THE KEY CHALLENGES AND PROVIDES PRACTICAL SOLUTIONS TO IMPROVE WATER SUPPLY SYSTEM PERFORMANCE AND EFFICIENCY.

THANK YOU FOR YOUR TIME!

References

EU Standards and Directives:

1. Regulation (EU) No. 305/2011 – Construction Products Regulation (CPR)
2. Directive 2020/2184/EU (formerly 98/83/EC) – On the Quality of Drinking Water
3. Directive 91/271/EEC – On Urban Wastewater Treatment
4. Directive 98/83/EC on the Quality of Water Intended for Human Consumption (revised to 2020/2184/ES)
5. Directive 2009/28/EC on the Use of Renewable Energy
6. EN 805:2000 – Water Supply Systems. External Pipelines and Their Components
7. EN 806 (Parts 1-5) – Drinking Water Supply Systems in Buildings
8. EN 12201 – "Plastic Pipes and Fittings for Water Supply"
9. EN 12897 – "Compensators for Water Supply Systems"
10. EN 12502 (Parts 1-5) – Metallic Pipes for Water Supply – Corrosion Prevention
11. EN 12566 (Parts 1-7) – Small Wastewater Treatment Plants
12. EN 1567:1999 – Pressure Regulators for Water Supply Systems
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DISCOVER THE KNOW-HOW OF CONSTRUCTION PROFESSIONALS
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Design for Disassembly and Adaptability - the future of construction.

Examples from around the world.

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Co-funded by the European Union

A PROPOS
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Involved in the real estate and construction industry for 20 years in Poland for French companies such as : ACCOR (investor, construction of new hotels in Poland), ATALIAN (facility management), COPLAN (design office & project management), ITM Poland (investor, construction of new Intermarché and Bricomarché), RD bud (general contractor from Rabot Dutilleul group).

Currently - educator and promoter of sustainable construction - innovative, responsible, fulfilling sustainable development goals, EU taxonomy and ESG rules.
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DESIGN FOR DISASSEMBLY AND ADAPTABILITY – ONE OF THE CIRCULAR ECONOMY BUSINESS MODELS ENABLING DECARBONIZATION

- **DESIGN FOR DISASSEMBLY AND ADAPTABILITY**
- **PRODUCT-AS-A-SERVICE (PAAS)**
- **MATERIAL PASSPORTS & DIGITAL TWINS**
- **MODULAR CONSTRUCTION**
- **REUSE & URBAN MINING**
- **SHARING PLATFORMS**
- **PREVENTION OF WASTE**
- **CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT**

Design for disassembly and adaptability is expected to become much more widespread and strategically significant for businesses aiming to meet emerging circular economy standards and competitive expectations.

DESIGN FOR DISASSEMBLY AND ADAPTABILITY
ONE OF THE CIRCULAR ECONOMY BUSINESS MODELS

DfD Definition :

a design strategy that enables products, components, or buildings
to be easily, safely, and efficiently taken apart, allowing the recovery of materials or reuse of elements at the end of their original life cycle.

Role of DfD in circular economy :

- ❖ Supports reuse and recycling of materials
- ❖ Reduces waste and disassembly costs
- ❖ Enables adaptation and modernization of products and buildings over time
- ❖ Creates economic and environmental value by keeping materials in the loop.

DESIGN FOR DISASSEMBLY (DfD)
EU REGULATIONS

Directive (EU) 2018/851 – Amendment to the Waste Framework Directive

EU Green Deal – Sustainable Built Environment Strategy *(upcoming under the new EU Sustainable Products Regulation)*

Level(s) – EU Framework for Sustainable Buildings *(voluntary tool)*

Directive 2008/98/EC – Waste Framework Directive (WFD)

EU Strategy for Sustainable and Circular Textiles and Construction Products Initiative (CPI)

Regulation (EU) No 305/2011 – Construction Products Regulation (CPR) *(under revision)*

EU Construction and Demolition Waste Management Protocol *(European Commission guideline)*

EU Taxonomy Regulation (EU) 2020/852

Circular Economy Action Plan (CEAP) *(part of the European Green Deal)*

Directive 1999/31/EC – Landfill Directive

Key Definitions from ISO 20887:2020
CIRCULAR DESIGN CONCEPTS

ISO 20887:2020 — Sustainability in buildings and civil engineering works — DESIGN FOR DISASSEMBLY AND ADAPTABILITY — Principles, requirements and guidance

DISASSEMBLY
Non-destructive taking-apart of a constructed asset into materials or components.
How, in a controlled way, separate and preserve materials and components for reuse, recycling or recovery?

ADAPTABILITY
The ability to be changed or modified to make suitable for a particular purpose.
How a built asset can respond to changing needs throughout its life cycle?

CONVERTIBILITY
Ability to accommodate substantial changes in user needs by making modifications.

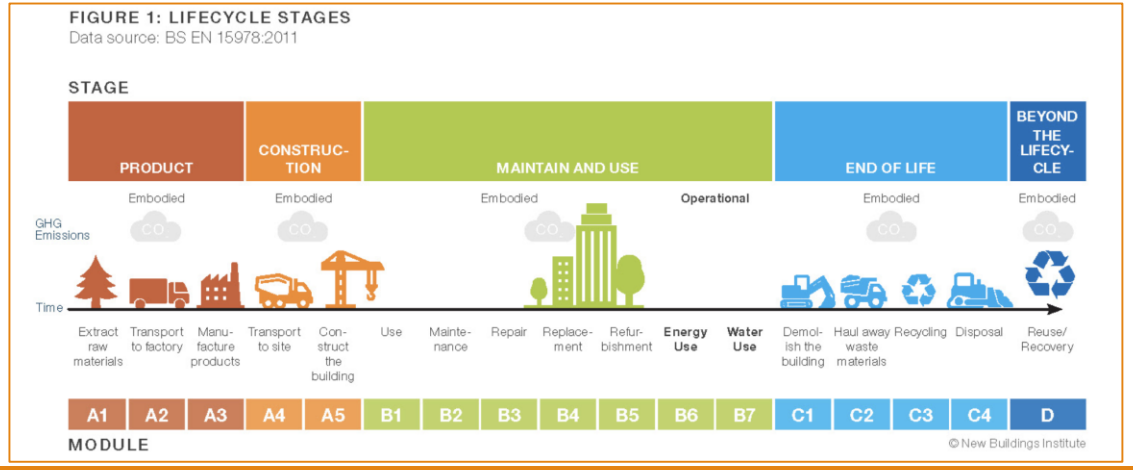
EXPANDABILITY
Ability of a design or system to accommodate substantial change that supports adding new space, features, capabilities or capacities.

VERSATILITY
The capacity to accommodate different functions with minor system modifications.

DESIGN FOR DISASSEMBLY (DfD)
FUTURE-ORIENTED MATERIALS SELECTION

MATERIALS ARE CHOSEN WITH CONSIDERATION FOR FUTURE IMPACTS AND THAT HAVE HIGH QUALITY WILL RETAIN VALUE AND/OR BE MORE FEASIBLE FOR REUSE AND RECYCLING.

- Durability and long service life
- Material value retention
- Recyclability and reuse potential (minimization of material contamination)
- Future regulatory and market readiness
- Reduced environmental footprint over the lifecycle
- Standardized connections
- Material labeling to facilitate sorting and recycling



https://www.aisc.org/aisc/sustainability/environmental-product-declarations/

DESIGN FOR DISASSEMBLY (DfD)
MODULARITY

DESIGNING BUILDINGS WITH INTERCHANGEABLE PARTS THAT CAN BE EASILY REPLACED OR UPGRADED.

- Modular façades and envelopes
- Modular building services such as mechanical, electrical, and plumbing systems
- Modular interior layouts
- Modular structural systems
- Modular energy systems
- Buildings designed as long-term platforms

De Zalmhaven (Rotterdam, NL) A fully completed mixed-use residential complex with the tallest prefab residential tower in the Benelux – completed in 2022.

HOHO Vienna - high level of prefabrication and a modular hybrid timber system, enabling faster assembly and greater flexibility over the building's life cycle. While not explicitly designed as a fully demountable structure, its standardized components and modular logic align with Design for Disassembly principles by supporting adaptability, selective replacement, and future material recovery.

https://dezalmhaven.com/blog/bijzonder-gebouwd/

https://construsoftbimawards.com/pl/de-zalmhaven

https://www.hoho-wien.at/homepage

DESIGN FOR DISASSEMBLY (DfD)
REVERSIBLE CONNECTIONS

USING FASTENERS LIKE BOLTS AND SCREWS INSTEAD OF ADHESIVES OR WELDING TO FACILITATE EASY DISASSEMBLY.
INTERCHANGEABILITY AND STANDARDIZATION FACILITATE REUSE.

- Design for easy disassembly
- Support for reuse and recycling
- Flexibility for future upgrades
- Reduced material waste
- Alignment with circular economy principles
- Lower lifecycle costs

MATRIX ONE – AMSTERDAM, HOLAND
DESIGNED TO BE DISMANTLED

https://www.mvrdv.com/news/4393/matrix-one-demountable-office-laboratory

DESIGN FOR DISASSEMBLY (DfD)
REVERSIBLE CONNECTIONS

Advertorial / Advert

HULCO® Anchor Bolts and BOLTED CONNECTION tool for designers

Get bolted – A new tool and solution for bolted connections

Bolted connections are known for their ease and speed of assembly. They offer a reliable solution that requires significantly fewer onsite workers with no temporary bracing needed. To further ease the work of designers and construction companies, Peikko continuously develops and improves its solutions and tools for bolted column connections. Peikko has now launched HULCO® Anchor Bolt and Peikko Designer® BOLTED CONNECTION design software.

HULCO® Anchor Bolt – simply strong

Peikko's comprehensive product family of bolted column connections has just welcomed a new member; HULCO® Anchor Bolt. HULCO® is a compact and cost-efficient solution with remarkable load-bearing capacities for heavy-duty bolted connections. It is designed to match with BOLDA® column shoes, a new generation of high-load capacity column shoes by Peikko. HULCO® replaces Peikko's PPM® L Anchor Bolts.

HULCO® is especially suited for industrial construction, and its assembly onsite is straightforward. The simple design speeds up its manufacturing process whereas the packaging is compact; ensuring an optimal amount of HULCO® Anchor Bolts to fit into a given truck space.

https://www.peikko.com/products/product/hulco

The role of fasteners in sustainable construction

Building for the future: fasteners and sustainability

Sustainable construction isn't just about recycled materials or solar panels, it's about how buildings are designed, assembled, maintained, and deconstructed. Fasteners are small components that make a big difference in the environmental performance of a structure.

Here's how the right fastening choices can support greener, longer-lasting buildings.

1. Enabling modular and disassemble design

https://www.unitedfasteners.com.au/news-and-insights/the-role-of-fasteners-in-sustainable-construction

In today's global shift toward environmental protection, low-carbon development, and a circular economy, **stainless steel fasteners** have come to represent far more than durability. They are increasingly recognized as a **sustainable, eco-friendly, and dependable material choice**. As a leading stainless steel fastener manufacturer in China, Meigesi firmly believes our products should not only deliver high performance but also reflect our deep responsibility to the planet. This is the commitment we sincerely extend to our customers across Europe.

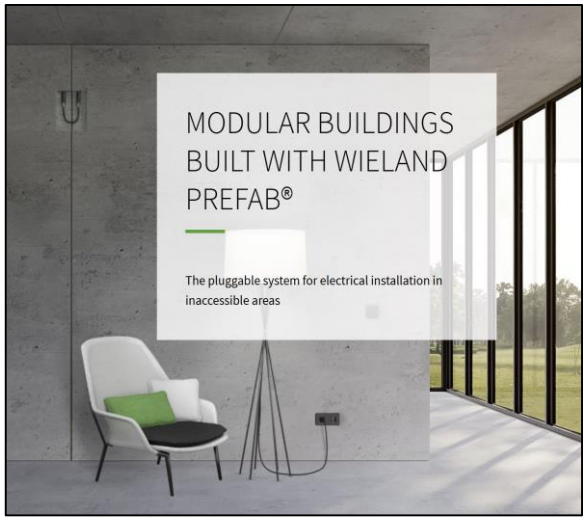
Why Stainless Steel Fasteners Are an Inherently Sustainable Choice

https://www.meigesi.com/sustainable-stainless-steel-fasteners-meigesi

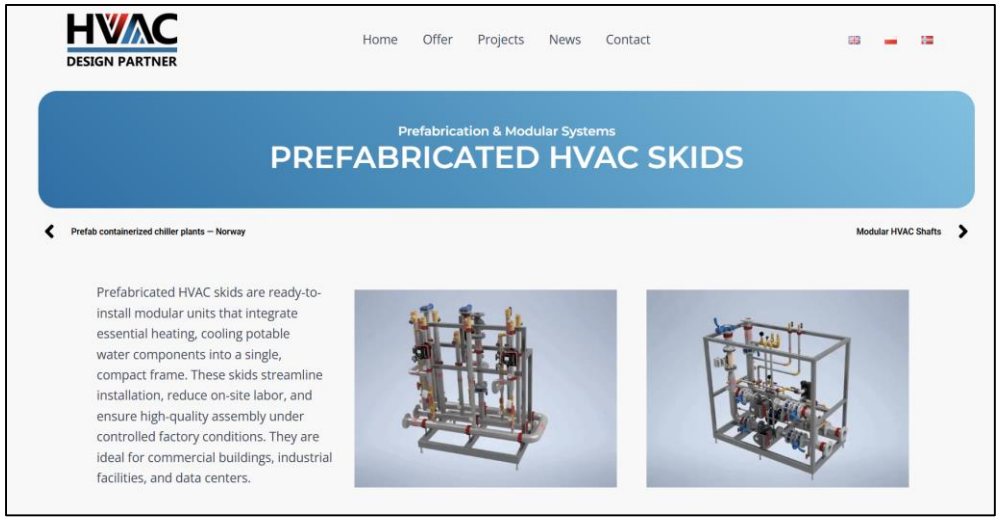
DESIGN FOR DISASSEMBLY (DfD)
STANDARDIZED COMPONENTS

UTILIZING STANDARDIZED COMPONENTS TO SIMPLIFY THE DISASSEMBLY PROCESS AND ENSURE COMPATIBILITY WITH FUTURE SYSTEMS

- Buildings designed for easy disassembly and reuse
- Standardized fasteners and connections
- Modular façade and envelope systems
- Standardized MEP modules (mechanical, electrical, plumbing)
- Repeatable interior elements and layouts
- Interchangeable structural components
- Compatible components for future upgrades



https://www.wieland-electric.com/en/home/wieland-prefab/



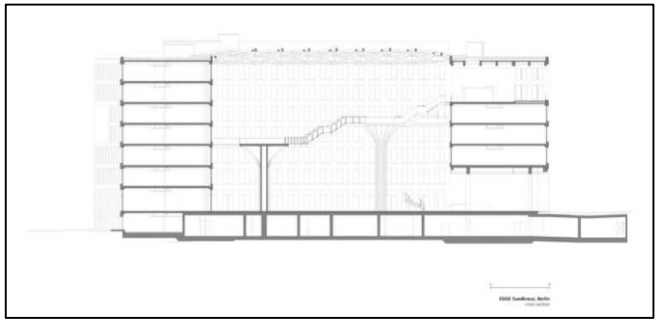
https://hvacdesignpartner.com/prefabricated-hvac-skids/

DESIGN FOR DISASSEMBLY (DfD)
MATERIAL DOCUMENTATION AND METHODS FOR DECONSTRUCTION

- Comprehensive Material Passport – detailed digital record of every material/component in a building, including quantity, type, origin, and reuse potential (used as future deconstruction guidance).
  Platform Example: Madaster Database.

- As-built drawings labeling of connections and materials / "deconstruction plan" in the specifications

- Documentation Purpose
  - enables traceability of materials throughout life cycle
  - supports circular economy and future disassembly
  - helps assess CO_2 storage and reuse potential.



https://www.archdaily.com/992168/edge-suedkreuz-berlin-offices-tchoban-voss-architekten

DESIGN FOR DISASSEMBLY (DfD)
SIMPLICITY OF STRUCTURE AND FORM

- Open-span structural systems
- Simple building forms
- Standardized dimensional grids
- Incremental construction and deconstruction
- Reduced material waste and disruption

CIRCL

Location: Amsterdam, Netherlands

Building purpose: Multi-purpose facility (e.g., bank headquarter, service premises, co-working spaces)

Type of work: New construction

Year of completion: 2017

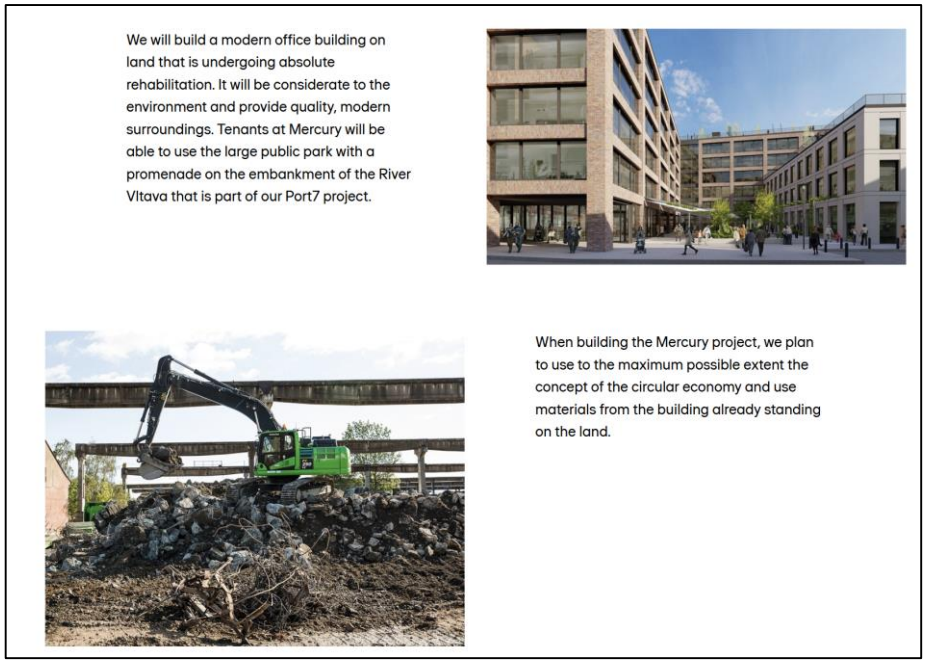
The Circl pavilion was the first project to implement sustainable and circular design in the Netherlands practically. Within the project, all main aspects of circular construction were considered. Firstly, various materials and products were directly reused (e.g., old glazed facade) or remanufactured/recycled and reused (e.g., old jeans made into insulation) in the pavilion construction. Secondly, the building was designed to minimise the use of materials and waste generation. Moreover, permanent and destructive connections were avoided to enable the dismantling of the materials/elements and reusing them in the future. Thirdly, using moving walls increased the building's spatial flexibility (reversibility), adaptability, and sharing potential. Additionally, some elements are leased as "object as service". Last but not least, all materials and elements are recorded as a "digital twin" and stored as the building's passport).

https://circon.graennibyggd.is/en/examples

DESIGN FOR DISASSEMBLY (DfD)
SAFE DECONSTRUCTION

- Selective deconstruction instead of demolition
- Hazardous material assessment and separation
- Documentation & material tracking
- Modular and reversible connections
- Health & safety protocols
- Integration with circular economy goals

https://upperone.pl/en/news/atrium-international-demolition-process-begins



https://www.skanska.cz/en-us/Expertise/development/commercial-development/projects-in-pipeline/mercury/

DESIGN FOR DISASSEMBLY (DfD)
Example of VENLO City Hall (Netherlands)

venlo

VENLO

CITY HALL FROM CRADLE TO CRADLE

Building future prosperity for citizens, the economy and the environment

GOVERNANCE
Municipal Council of Venlo

POPULATION
101,000

DENSITY
1,625 per km²

AT A GLANCE

THE INITIATIVE

From the outset, it was decided that the design of the new Venlo City Hall (NL) should be Cradle to Cradle (C2C) certified and situated in an area in need of regeneration. The vision was to create a building that would enable better connections between different city departments, and that would show consideration for the health of workers, visitors and the surrounding environment. These considerations were in addition to the aim of creating long-term cost benefits from material choices and energy saving technologies.

As one of the schools of thought that underpin the circular economy, C2C design allows for continuous material recovery and reutilisation in a technical or biological system. Through healthy material choices and design for disassembly, it is possible to recoup some of the original investment, at a later date, as materials can be sold back to manufacturers through a 'buy and buy-back' scheme, and ultimately used again. In designing Venlo City Hall, careful attention was given to the structure of the building, and also to the interior fit-out and furniture installed. The close attention to detail extended to the procurement of products within the building, such as soap.

TIME FRAME

In 2007 it was decided that all new city buildings would be designed using C2C principles.
The design of Venlo City Hall began in 2009. Construction commenced in 2012 and was completed in April 2016. The building opened for use in August 2016.

FOCUS AREAS

While the primary focus for this initiative was in the built environment, it was driven by the aims of capturing long-term economic savings, protecting the environment and human health, and promoting skills and ambition in the city.

CORE TEAM & PARTICIPANTS

Of more than 50 initial proposals submitted in response to the specifications of the tender, five were shortlisted before the ultimate choice was made. The final project team consisted of eight people, including a lead civil servant, technical advisors, financial advisors and the architects. The team created roadmaps for each of the different areas that the project would need to address - from the planning of the building, to the user needs, to the financing of construction. Overall sign-off resided with the mayor, council and aldermen.

FINANCE

The city council's allocated budget for the project was EUR 53 million. It was supported by a loan from Bank Nederlandse Gemeenten - a local government funding agency. When the project came in under budget, EUR 900,000 were returned to the city council for reinvestment in other areas.

THE JOURNEY

ORIGINS

In 2006, in an effort to evolve its image and economy, the city of Venlo along with the Chamber of Commerce committed to embed C2C principles into the city's economic activities. When it became necessary to renovate the original city hall these principles were kept in mind, however the structural layout of the old building did not allow for a suitable transformation of the physical space or its function in terms of power generation, energy savings, improved air quality, grey water processing, heating or cooling. The mayor, council and aldermen therefore approved the case for a new city hall to be built using C2C principles and located in an area that would benefit from the investment.

In line with EU regulations, a European design tender was issued, with a brief to provide the most innovative vision for a C2C town hall. The winning bid would need to meet the overarching ambition to design and build a space that would benefit people, the environment, and the economy.

BUILDING DESIGN

Venlo City Hall was built on the edge of the River Meuse in an area that would benefit from regeneration and economic development. The new building has already catalysed renovation of an old neighbourhood factory which now contains living accommodation. An additional 72 new dwellings are also being constructed next to Venlo City Hall using C2C principles.

The building's living north facade comprises over 100 plant varieties which serve to improve the air quality outside the building. This living facade not only converts carbon dioxide to oxygen and filters particulates, it also provides a level of noise insulation and creates a habitat for birds and insects. An interior green wall helps to add moisture to the air inside the building.

The building's connections to natural systems also minimises the draw on resources. Rainwater is collected on the roof where it makes its way to a helophyte filter, a type of reed bank, along with wash basin and pantry water. The filtered water is then used for flushing toilets. In addition, 1,300 m² of solar panels have been added to the exterior to provide power and shade.

Two solar chimneys also passively heat and cool the building. One is on the top of the building and the other is on the upper levels. In simplified terms, these solar chimneys capture heat from the sun and create thermals which circulate air throughout the building. Heat exchangers and air wells are used to regulate the temperature according to the seasons. The design is both attractive and saves money and energy as the building doesn't require traditional heating or cooling systems. In addition, when temperatures range between 18-22°c , the pleasant open space inside the solar chimney on the upper levels can be occupied by workers.

The components in the building are documented in a digital 'material passport' that discloses the material constituents, along with how to disassemble, then recycle or return them to the manufacturer - thereby recouping a proportion of the original investment. By creating a log of the residual material value within the building it becomes possible to quantify the potential value of buildings as material banks.

In a similar vein, the furniture in the building is also provided under a 'buy and buy-back' arrangement and is easy to disassemble for maintenance, ensuring workable components can be reused. Material choices within the furniture facilitate recyclability.

Certain materials have also been avoided - in this case paint and glue, in part due to the lack of ingredient transparency and in part to ensure material health and aid the future recovery of materials.

ELLEN MACARTHUR FOUNDATION

http://www.ellenmacarthurfoundation.org/our-work/activities/circular-economy-in-cities

https://content.ellenmacarthurfoundation.org/m/41acd38e5468339 1/original/Venlo-Case-Study-Mar-19.pdf

https://knowledge-hub.circle-economy.com/article/30013?n=Cradle-to-Cradle-Construction-of-Venlo%E2%80%99s-New-City-Hall&utm

THANK YOU FOR YOUR ATTENTION

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AI in Construction

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https://scholar.google.com/citations?user=SIG81uEAAAAJ&hl=pl&oi=ao

AI-driven design and planning

Core idea: **use AI to accelerate design, generate alternatives, verify compliance, improve coordination and support multi-discipline workflows**

AI-driven design generation
Models that create multiple architectural, structural or installation variants from requirements and constraints. Used from early-stage concept evaluation, site layouts, infrastructure alignments, utility routing and value engineering.

Examples (today):

Automatic assist of structural scheme generation (beam–column grids, bridge spans, foundation typology) with load combinations.

Future:

Fully automated multi-discipline design generation basing on drone scans, legal constraints, investor requirements and internal standards.

AI-driven design and planning

AI-driven design verification
Automated checking of drawings and BIM models for compliance with: law regulations, technical specifications, fire safety, evacuation routes, accessibility, environmental requirements. Tools should identify conflicts, missing data, geometry issues and prepare draft deviation reports with propositions of possible solution.

Examples (today):

Compliance checking of evacuation routes, door widths, fire compartments, accessibility and sanitary regulations.
Detection of missing dimensions, incorrect level references, conflicting specifications or incomplete legends.

Future:

Autonomous “digital reviewer” producing complete deviation reports with suggested solutions, KPI’s, risk registers.

AI-driven design and planning

Building permits and regulatory automation
AI analyses local plans, decisions on development conditions, utility guidelines and H&S or environmental requirements. AI produces compliance summaries and risk notes for designers before submission for building permit.

Examples (today):

Automatic extraction of key local plan parameters (intensity, height limits, green area, setbacks)

AI classification of utility guidelines and preparation of compliance checklists.

Future:

AI producing complete “permit submission packages” including descriptions, forms and attachments.

AI-driven design and planning

BIM parameterization and model cleanup
Automated extraction and structuring of BIM data: object parameters, materials, equipment lists, construction quantities. AI cleans models delivered by external designers, reducing time needed for manual coordination.

Examples (today):

Automatic standardization of object parameters (naming, consistency, material codes).
Removal of redundant geometry, fixing broken solids and normalizing object categories (walls, ducts, floors).

Future:

AI automatically „repairing” external designer models into company-standard models without manual intervention.

AI-driven design and planning

Design-to-execution consistency checking
AI compares tender drawings, descriptions, as-built models, specifications and designer technical revisions to catch inconsistencies early. Generates alerts before issues result in rework or cost claims.

Examples (today):

Comparing tender project technical descriptions with revision updates to identify scope of changes before contracts are signed

Future:

AI providing continuous real-time consistency checks between design, procurement data and site progress.

AI-enabled construction management and site operations

Core idea: **improving execution, H&S, logistics and supervision using real-time analytics, cameras, sensors and predictive algorithms**

AI-driven site monitoring
Cameras + computer vision detect unauthorized presence, H&S violations, missing PPE, excavation risks, restricted area entry, equipment conflicts and material misuse. Automatic alerts reduce dependence on security and manual supervision.

Examples (today):

Detecting H&S violations: missing helmets, unsafe work at height, workers entering restricted zones.
Identifying improper equipment use (overloaded excavators, unsafe crane operations).
Recognizing unauthorized entry or material theft.

Future:

AI predicting „risk hotspots" based on worker density, weather and task type or other parameters that could be important.

AI-enabled construction management and site operations

Autonomous inspections with drones and robots
Drones with AI image analysis perform inspections of façades, roofs, trenches, roads, earthworks and concrete elements. Robots handle repetitive or hazardous tasks (tight spaces, height work, night surveillance).

Examples (today):

Drone inspections of façades, roofs, excavations, concrete surfaces and bridge structures.
Robotic monitoring of confined spaces (tunnels, ducts, crawlspaces).
Nighttime surveillance robots detecting intrusions and hazards.

Future:

Autonomous swarm drones doing fully automated daily inspections and uploading deviations

AI-enabled construction management and site operations

Automated progress tracking
AI compares camera footage, drone scans and BIM to planned schedule. Identifies delays, productivity deviations and missing elements. Creates daily/weekly status reports without manual data entry.

Examples (today):

Comparing drone point clouds with BIM to calculate completed volume of earthworks.
AI identifying installed vs missing components (doors, windows, facade panels).
Progress curves generated automatically from CCTV streams.

Future:

Fully automated real-time progress reports with delay forecasts and impact analysis. Proposing better solutions.

AI-enabled construction management and site operations

Smart resource and equipment management
AI optimizes allocation of labour, machinery and tools across multiple sites. Predicts demand peaks, reduces idle time and plans material deliveries to minimize downtime.

Examples (today):

Predicting crane or excavator demand based on progress and weather.
Optimizing deliveries (concrete, steel, prefabs) to reduce idle time.
Forecasting labour shortages and overtime risk.

Future:

Autonomous resource optimisation engine coordinating all equipment across a portfolio of projects.

AI-enabled construction management and site operations

Predictive H&S risk analytics
System integrates data from incidents, near-misses, site layout, weather, worker movement and equipment logs. Predicts high-risk zones and proposes preventive actions. Supports training with VR-based simulations.

Examples (today):

Combining weather, geolocation and task type to forecast slips, falls and heat-risk events.
Correlating equipment logs with accident history to highlight high-risk behaviours.
VR-based simulations for high-risk tasks (lifting operations, confined space entry)

Future:

AI that dynamically redesigns site layout to reduce predicted H&S risk areas.

AI-powered laboratory, testing and quality control

Core idea: **automate data capture, interpretation and verification for construction materials, environmental monitoring and laboratory workflows**

Automated temperature and quality monitoring of materials
Sensors + AI analyse temperature profiles of asphalt mixes, concrete curing, stabilizing layers and prefabricated components. Detects out-of-range parameters and provides early warnings.

Examples (today):

Quality control of prefabricated elements using camera-based defect detection.

Future:

Self-adjusting material processes (asphalt, concrete, stabilization) controlled directly by AI.

AI-powered laboratory, testing and quality control

Digital laboratory logistics and material traceability
AI plans sample collection routes, tracks laboratory equipment, manages calibration schedules and automatically generates test reports from sensor data.

Examples (today):

Automated routing of sample pickups based on site needs and lab workload.

AI scheduling equipment calibration and notifying when devices approach error thresholds.

Future:

Fully autonomous lab workflows with robotic sample processing and AI interpretation.

AI-powered laboratory, testing and quality control

Automated interpretation of test results
AI checks compliance of laboratory outcomes with standards, norms and contract requirements. Highlights deviations and generates draft corrective actions.

Examples (today):

Automatic comparison of lab results with norms and specifications.
AI detecting irregularities in density, moisture, voids, content, compaction.
Generation of preliminary corrective recommendations.

Future:

AI validating entire test batches and generating final approval or rejection recommendations/decisions.

AI-powered laboratory, testing and quality control

Environmental and water management analytics
AI optimizes water reuse on site (rainwater systems), monitors environmental parameters, predicts contamination risks and supports ESG reporting.

Examples (today):

Optimization of greywater and rainwater usage for dust control and curing.
Real-time monitoring of air quality, noise, runoff and soil conditions.
Early warning of contamination or overflow risk.

Future:

AI predicting short and long-term environmental impact and optimizing mitigation measures.

AI-powered laboratory, testing and quality control

Drone-based geotechnical and road condition analysis
AI processes drone photogrammetry and LiDAR to detect compaction defects, cracks, settlement zones, surface deformations and drainage anomalies.

Examples (today):

Drone LiDAR detecting rutting, cracks, drainage issues, deformations.
Photogrammetry identifying settlement or compaction defects.
Remote inspection of roads, embankments and slopes.

Future:

Drone fleets and sensors generating real-time „condition maps” for entire road networks.

AI-supported back-office, procurement and document automation

Core idea: **eliminate thousands of hours of manual work through automated document creation, extraction, negotiation support and knowledge bases**

Automated document generation
AI produces templates for specifications, quality plans, method statements, attachments, reports, change orders and claims. Learns internal company standards and ensures consistency across projects.

Examples (today):

Generating specifications, quality plans and method statements instantly from templates.
Automatic creation of attachments, protocols, risk sheets and reports.
Preparing draft change orders and claims based on project data.

Future:

AI preparing complete documentation packages for tender submissions.

AI-supported back-office, procurement and document automation

Contract and subcontractor negotiation assistant
System analyses contract drafts, compares revisions, highlights changes, extracts risks and proposes negotiation positions. Automatically prepares unified text with tracked changes.

Examples (today):

Comparing revisions and extracting changes between contract versions.
Summarizing risks and recommending negotiation positions.
Generating unified contract text with tracked changes.

Future:

AI supporting live negotiations by predicting outcomes and suggesting optimized clauses; automatic „pairing" of partners depending on availability, type of work and other parameters of each one

AI-supported back-office, procurement and document automation

Automated verification of project documentation
AI evaluates tender documents, as-built files, technical descriptions and multi-discipline drawings for errors, gaps and inconsistencies. Produces summaries, risk notes, recommendations for managers.

Examples (today):

Scanning multi-discipline drawings for inconsistencies.
Identifying errors in BOQs, technical descriptions and model geometry.
Producing risk notes for managers.

Future:

Full automation of tender-document review including pricing anomalies/bid rigging detection

AI-supported back-office, procurement and document automation

Smart procurement and supplier intelligence
AI-powered search engine ranks subcontractors by financial condition, performance, price history, technical capability, and geography.
Supports automated RFQ distribution and preliminary price comparison.

Examples (today):

Ranking subcontractors by past performance, price history and technical capability.
Automatic RFQ distribution and initial price comparison.
Future:

Autonomous supplier-selection engine optimizing cost, time and risk. AI analyzing real-time market conditions (materials, labour, logistics).

AI-supported back-office, procurement and document automation

Integrated knowledge graph for all projects
Unified database linking contracts, drawings, lab results, correspondence, change logs and site records. AI answers questions across the entire knowledge set, improving decision-making and reducing repeated work.

Examples (today):

Linking drawings, contracts, correspondence and lab results into one searchable system.
AI answering queries („which revisions changed fire safety?”).
Automated extraction of lessons learned across projects.

Future:

Predictive knowledge management showing the best decision paths based on past projects.

Digital twin, asset intelligence and sustainable construction

Core idea: **integrate data across the full lifecycle — from planning to maintenance using whole data: models, sensors, technical documentation and real-time analytics**

AI-based digital twin of construction and operation
Real-time twin combining sensors, BIM and schedule. Displays progress, predicts future delays and simulates impact of design changes or supply disruptions.

Examples (today):

Real-time visualization of progress vs schedule using BIM and sensors.
Simulation of delays due to material shortages or design changes.
Predicting workforce and equipment needs.

Future:

Fully autonomous project-control system adjusting budget, schedules, logistics and resources.

Digital twin, asset intelligence and sustainable construction

Automated road and infrastructure performance analysis
AI evaluates pavement behaviour, rutting, cracks, drainage, traffic loads and maintenance needs based on sensor data and drone inspections.

Examples (today):

Automated inspections and data analysis.

Future:

Continuous infrastructure monitoring with autonomous repair recommendations. Repair procedures and operations performed by drones and robots.

Digital twin, asset intelligence and sustainable construction

Energy and resource optimisation on sites
AI predicts energy demand, optimizes placement of solar units, monitors fuel use, schedules machinery with minimal idle time and reduces operating costs.

Examples (today):

Predicting energy peaks and planning generator/PV usage.
Monitoring fuel consumption and optimizing machine idling.
Optimizing placement of mobile OZE units.

Future:

Fully AI-managed „minimum emission” site operations. Including formal agreements, site changes.

Digital twin, asset intelligence and sustainable construction

Waste management and on-site recycling analytics
AI recommends optimal use of recycled materials, monitors production from mobile mixing plants, forecasts material savings and environmental impact.

Examples (today):

AI detecting recyclable fractions (metal, concrete, plastic, wood).
Predicting required waste container volumes.

Future:

On-site robotic recycling stations producing reusable materials.

Digital twin, asset intelligence and sustainable construction

Predictive maintenance for site equipment
AI analyses vibration, telemetry and usage history of machinery to predict failures and optimize service intervals, reducing downtime and cost.

Examples (today):

Planning service intervals based on real usage rather than calendar schedule.
Identifying misuse or overload events.

Future:

Autonomous robots with maintenance planning and automatic ordering/changing of spare parts, services.

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