ANALYSIS STUDY: OPTIMAL LAMELLA APPLICATION FOR CIRCULAR CLARIFIERS

Brief Information About Lamella Systems

In water treatment plants, lamella systems are used to increase the efficiency of clarifiers. By using inclined plates or tube settlers, the separation of solids from water is accelerated, and the effective settling surface is increased. This allows for higher settling performance over shorter distances, improved effluent quality, and more efficient use of plant area. Lamella systems can be applied both in new facilities and in existing plants for capacity enhancement and operational improvements. They are a highly efficient solution.

- Lamella systems enable rapid and effective separation of suspended solids in clarifiers.
- Inclined plates shorten the settling path and increase the effective settling area.
- High treatment efficiency can be achieved in smaller footprints.
- The effluent water quality is significantly improved.
- They can be applied to existing facilities for capacity increase and operational optimization.

Lamella (inclined plate or tube settler) systems used in treatment plants are manufactured in different shapes depending on design and performance requirements. Fundamentally, there are two main types:

- **Slotted/Slidable or V-shaped Lamella**
- **Tube or Honeycomb Lamella**

Additional design considerations:

- The lamella angle is generally between 55°–60°; efficiency depends on the selected angle.
- Materials are mostly PVC or PP, with stainless steel frames preferred.
- The selection of lamella type depends on plant capacity, basin dimensions, and effluent quality requirements.

For **rectangular basins**, all types of lamella can be applied without major issues.

For **circular basins**, however, special lamella designs are often required.
Due to the slope of the radius/diameter, standard lamella types may create gaps, dead zones, structural blockages, and efficiency losses in application.

LAMELLA ANALYSIS FOR İSKİ – CUMHURİYET 2nd STAGE WATER TREATMENT PLANT

Evaluation of the İBB–İSKİ CAAT Asian Region Water Treatment Plant Lamella Project

Evaluation Scope:
The lamella project for the İBB–İSKİ CAAT – Asia Region Water Treatment Plant construction will be evaluated using four different methods:

- Suitability for circular basin geometry
- Compliance with height and volume requirements
- Computational modeling results
- Ease of maintenance and service

Key Design and Specification Data:

- The plant comprises six circular clarifiers, each with a diameter of 21 meters, equipped with a central sludge scraper.
- Lamella plates are designed to be **4.5 mm thick**, manufactured from **polypropylene (PP)**, with a minimum vertical height of **1.2 m**.
- The required lamella volume for six basins is approximately **3,000 m³** (i.e., ~500 m³ per basin).

Notes on Provided Data:

- The specified **4.5 mm plate thickness** exceeds typical industry practice. For shorter lamella (lengths of 100–140 cm), **1.2 mm** is usually sufficient; longer plates require greater thickness.
- Vertical lamella height: Although a minimum of 1.2 m is requested, the necessary volume per basin (~500 m³) requires a vertical height of **1.5 m** with an inclined plate length of **173 cm**.
    - Because the plate length exceeds 140 cm, 1.2 mm thickness is insufficient. A thickness between **1.5–2 mm** is a safer engineering choice.
- Color was not specified; however, **blue** is recommended for ISAT applications.
- According to TDK (Turkish Language Association), "approximately" indicates a value that may vary slightly above or below the stated figure. Hence, for the ~3,000 m³ lamella volume, values between **2,950–3,050 m³** are acceptable.
    - Using 1.2 m height and calculating ~350–400 m³ per basin would **not** be an appropriate engineering method.

Design Alternatives for İSKİ–CAAT Asia Drinking Water Treatment Plant:

1. **Design-1:** Rectangular BLOCK-TYPE lamella configuration
2. **Design-2:** Circular BLOCK-TYPE lamella configuration
3. **Design-3:** Circular FRAMED-TYPE lamella configuration

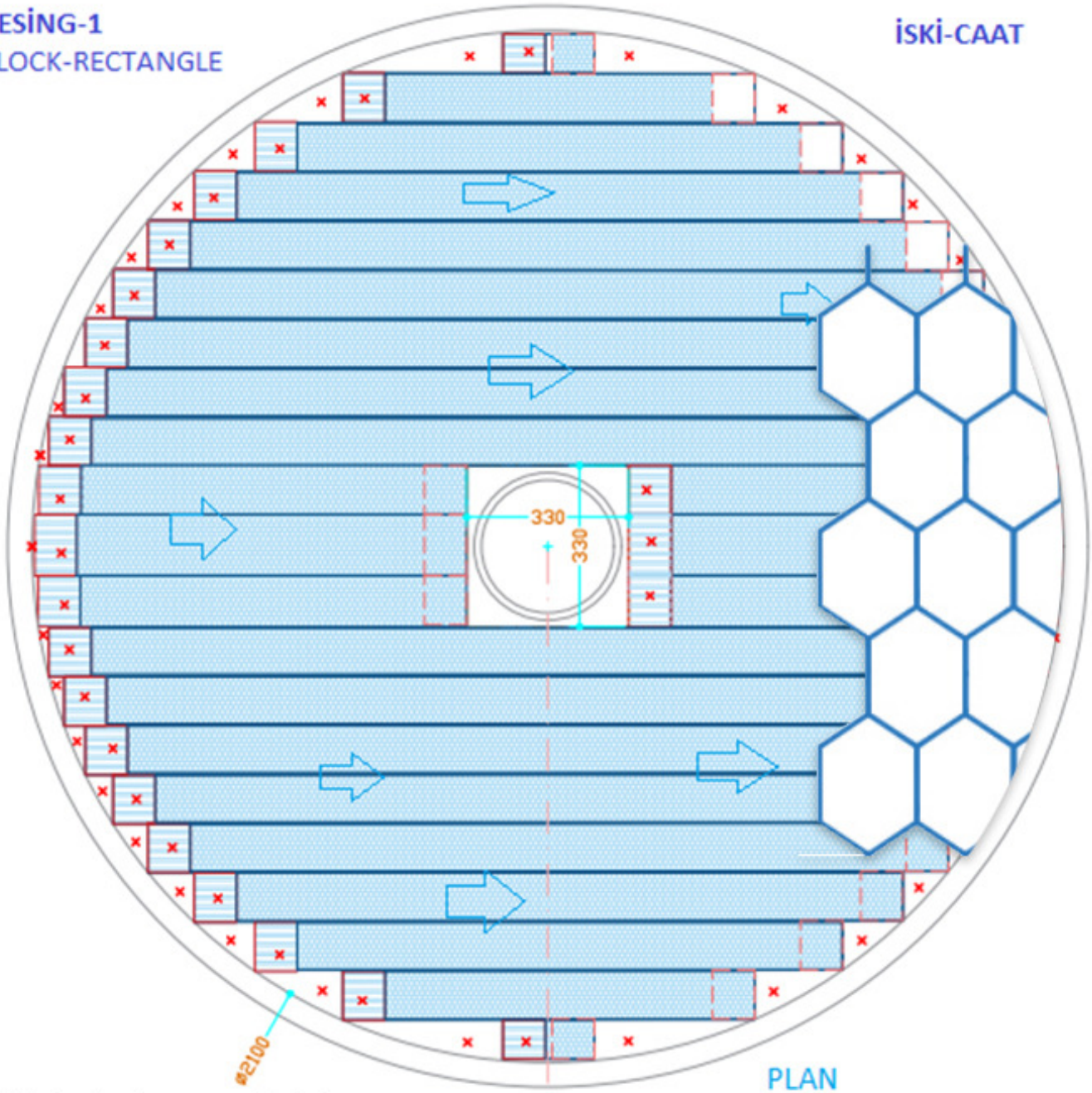
Notes:

- This evaluation was carried out by **ARBİOL**, a company with experience in lamella manufacturing and implementation since 2002.
- The document is intended for public sharing to inform industry stakeholders and authorities accurately.
- For comments and suggestions, please contact: **info@arbiol.com.tr**

Objective:
To provide accurate technical guidance to relevant professionals and authorities within the water treatment sector.

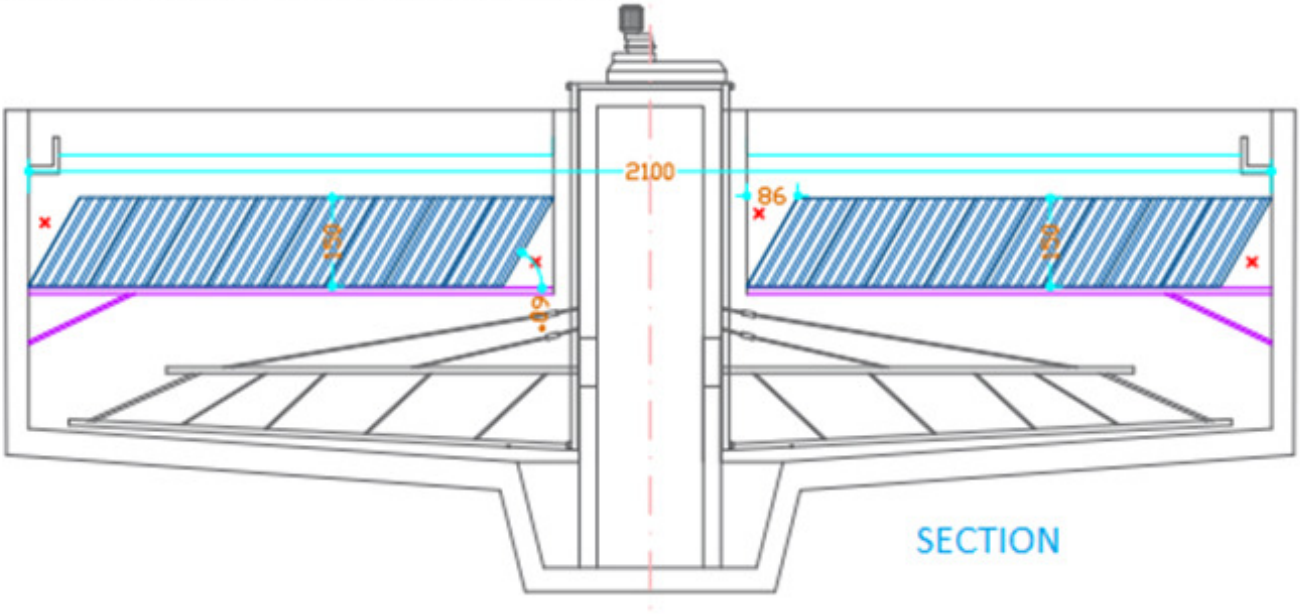
DESİNG-1
BLOCK-RECTANGLE

İSKİ-CAAT



PLAN

This design is now outdated;
A new design is available for circular basins.



SECTION

DESIGN-1: Rectangular Block-Type Lamella

General Assessment

The rectangular block-type lamella is one of the most economical solutions, as it does not require a frame. However, due to the circular shape of the basin, this design is **not suitable**. Areas marked "X" on the plan cannot be fully filled, and even if filled, water flow would be blocked, rendering it ineffective.
Conclusion: Therefore, it is not suitable.

Height and Volume Requirements

The specifications require a **minimum vertical lamella height of 1.2 m**. Additionally, approximately **500 m³ of lamella per basin** is needed. Calculated values:

- Lamella top surface area: ≈ 285 m²
- H = 1.20 m → VL = 285 × 1.2 = 342 m³
- H = 1.50 m → VL = 285 × 1.5 = 427 m³
- H = 1.75 m → VL = 285 × 1.75 = 499 m³

Based on these results, the required lamella height (Hx) for DESIGN-1 should be **175 cm**.
The specification only mentions 1.2 m, but the **500 m³ volume requirement cannot be ignored**.
Conclusion: Therefore, DESIGN-1 is not suitable.

Computer-Aided Modeling Results

- Model: **CT44**
- Inclination angle (SA): 60°
- Lamella height (H): 150 cm
- Width (W): 1700 cm
- Length (L): 1700 cm

Calculated results:

- Lamella volume (V): 433.5 m³ (L × W × H)
- Inclined length (LT): 173 cm
- Active area: 14.77 m²/m³
- Total basin surface area (A): 289 m²
- Total active (projection) area (Aa): 6,402.8 m²
- Suitable flow rate: 1,601 – 3,842 m³/h

Conclusion: According to modeling, DESIGN-1 is **also not suitable**.

Maintenance and Service

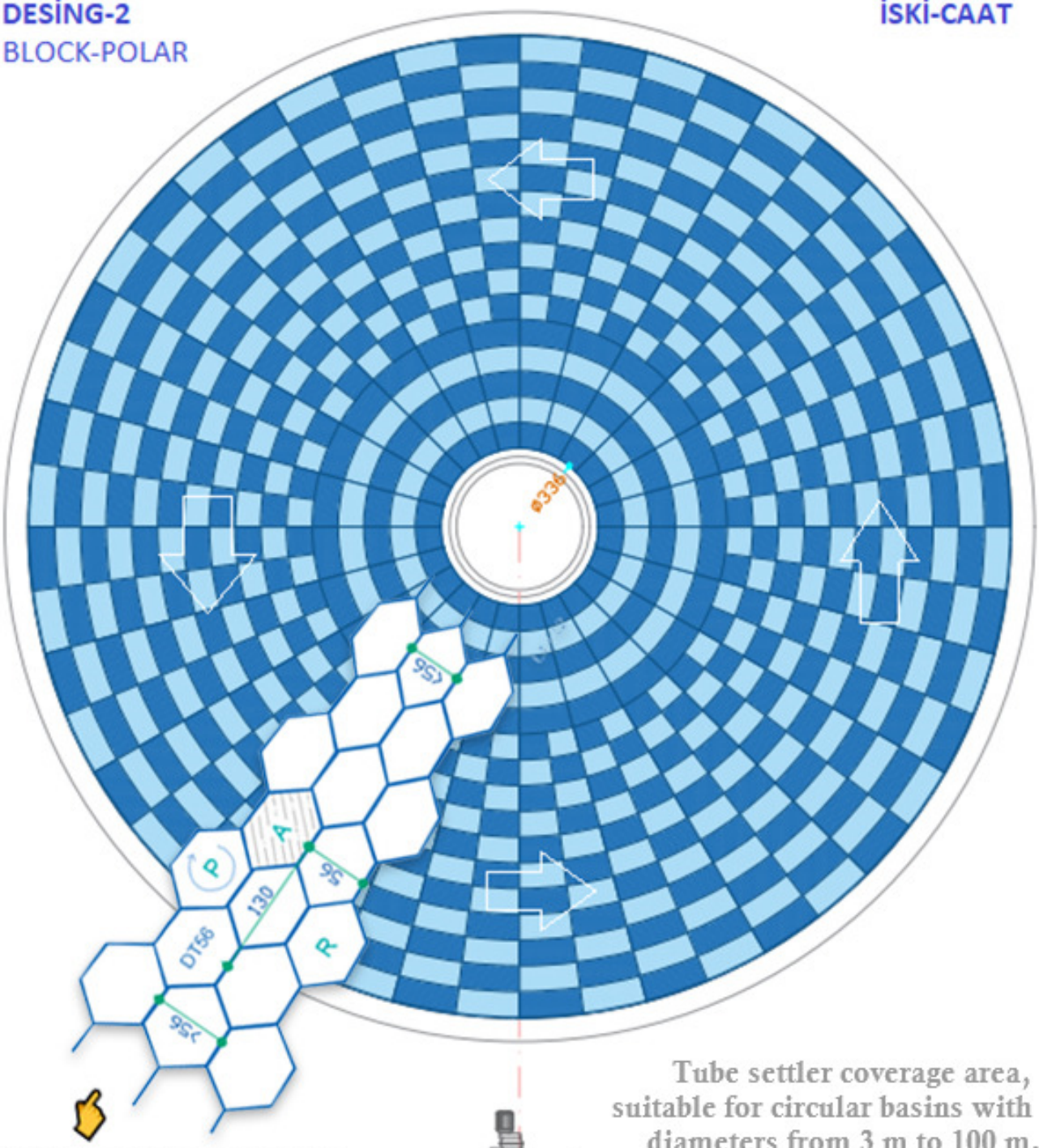
Rectangular block lamella systems are difficult to maintain. They lack lifting or handling equipment, and removing or reinstalling blocks—regardless of sludge load—requires significant time. Moreover, if a single lamella is damaged, the entire block must be replaced.
Conclusion: Maintenance and service difficulties make this design unsuitable.

Final Assessment (DESIGN-1)

- Suitability for circular basin: **Not suitable**
- Height & volume requirement: **Not suitable**
- Modeling results: **Not suitable**
- Maintenance & service: **Not suitable**

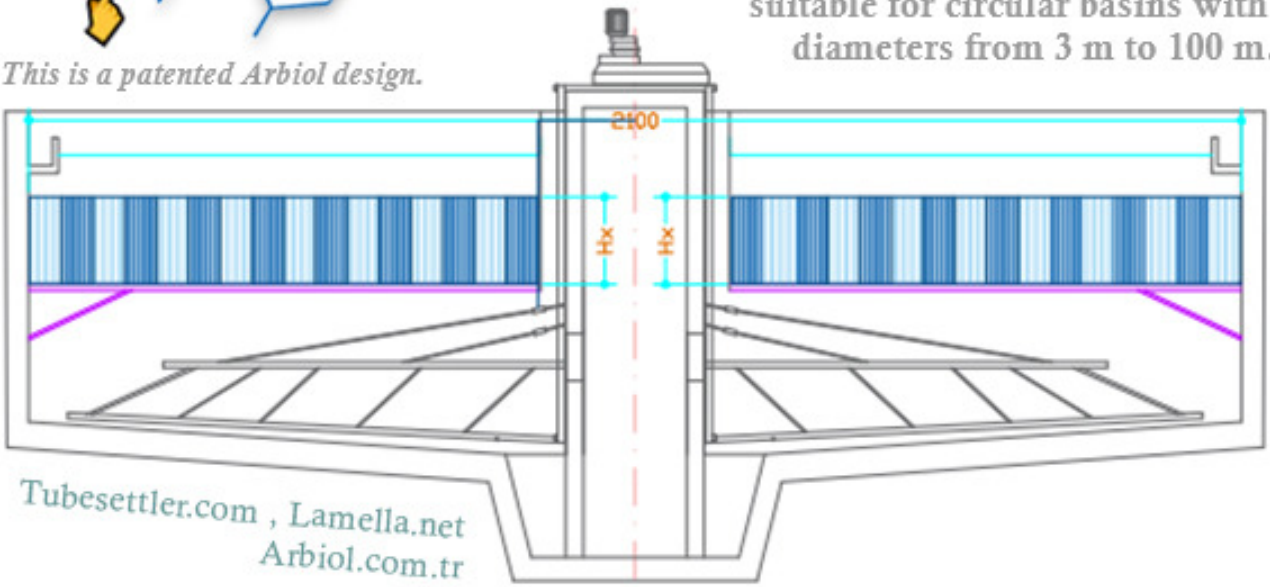
DESİNG-2
BLOCK-POLAR

İSKİ-CAAT



Tube settler coverage area, suitable for circular basins with diameters from 3 m to 100 m.

This is a patented Arbiol design.



Tubesettler.com , Lamella.net
Arbiol.com.tr

DESIGN-2: Polar Circular Block-Type Lamella

General Assessment
The polar circular block lamella is one of the most economical solutions, as it does not require a frame. Its special design for circular basins allows the tail section of each block to cover the lower void of the previous block. Consequently, no dead zones are formed in the areas marked "X" on the plan**.**

As a result, a **continuous, gap-free flow** is achieved, filling the entire basin surface.
Conclusion: Therefore, the polar block is suitable.

Height and Volume Requirements

The specifications require a **minimum lamella vertical height of 1.2 m**. Calculations based on the circular block design:

- Lamella top surface area: ≈ 335 m²
- H = 1.20 m → VL = 335 × 1.2 = 402 m³
- H = 1.50 m → VL = 335 × 1.5 = 502 m³

Based on these values, the lamella volume requirements are satisfied.
Conclusion: According to this calculation, it is suitable.

Computer-Aided Modeling Results

- Model: **DT56**
- Flow (Q): 2,500 m³/h
- Inclination angle (SA): 60°
- Lamella height (H): 150 cm
- Inclined length (LT): 173 cm
- Critical velocity (HV): 0.4 m/h

Calculated results:

- Lamella volume (V): 494.5 m³
- Required active (projection) area (Aa): 6,250 m²
- Active area for DT56 model: 12.64 m²/m³
- Surface area (A): 329.7 m²
- Surface loading rate: 5.1 m/h (Q/A)

Conclusion: According to the modeling results, it is suitable.

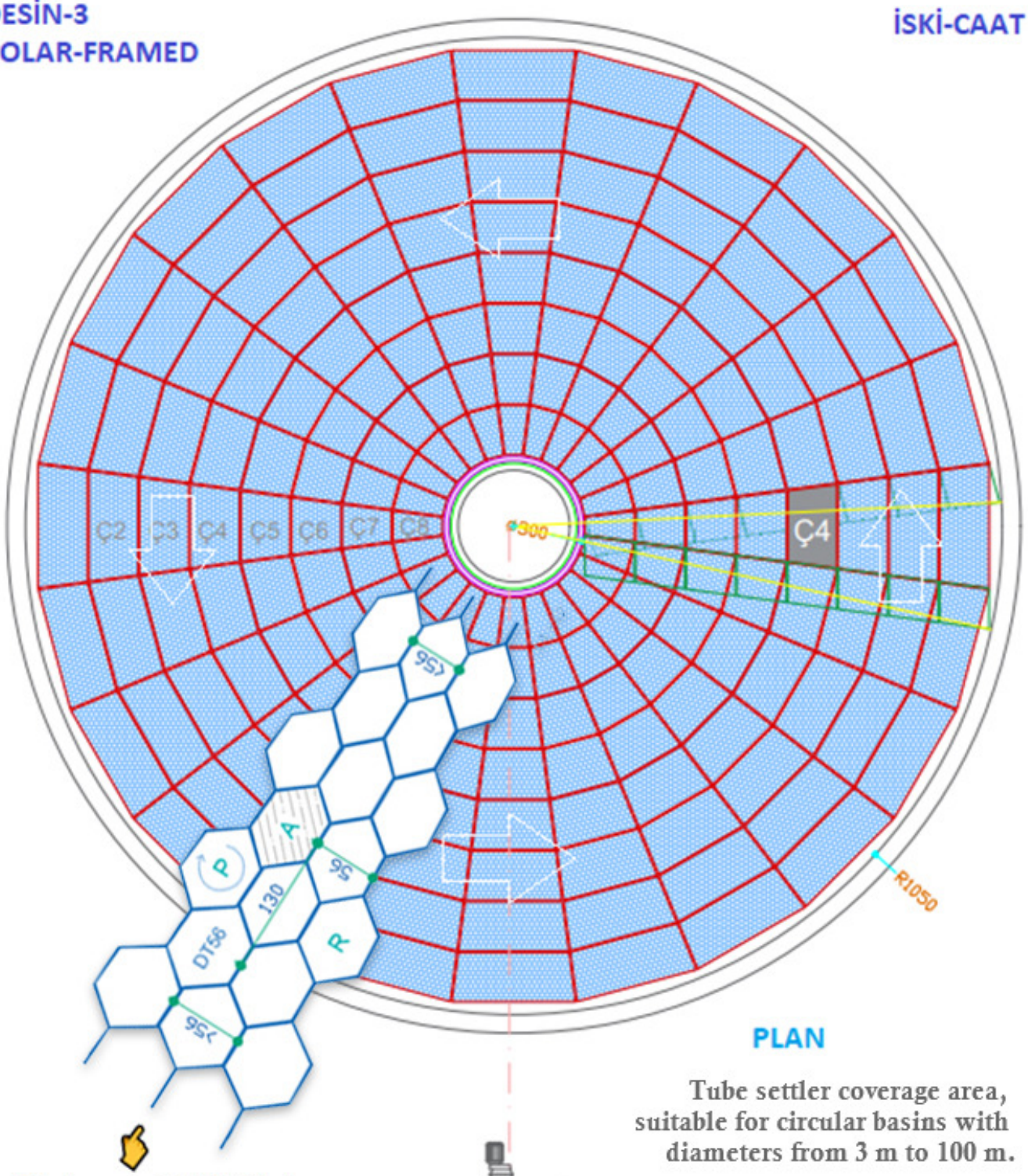
Maintenance and Service
Block-type lamella systems are difficult to maintain. Handling equipment (lifting devices, etc.) is not available. Regardless of sludge load, removing and reinstalling the blocks is time-consuming. Additionally, if a single lamella within a block is damaged, it cannot be replaced individually—the entire block must be replaced.
Conclusion: Maintenance and service difficulties make it **unsuitable**.

Final Assessment (DESIGN-2)

- Suitability for circular basin: **Suitable**
- Height & volume requirement: **Suitable**
- Modeling results: **Suitable**
- Maintenance & service: **Not suitable**

DESİN-3
POLAR-FRAMED

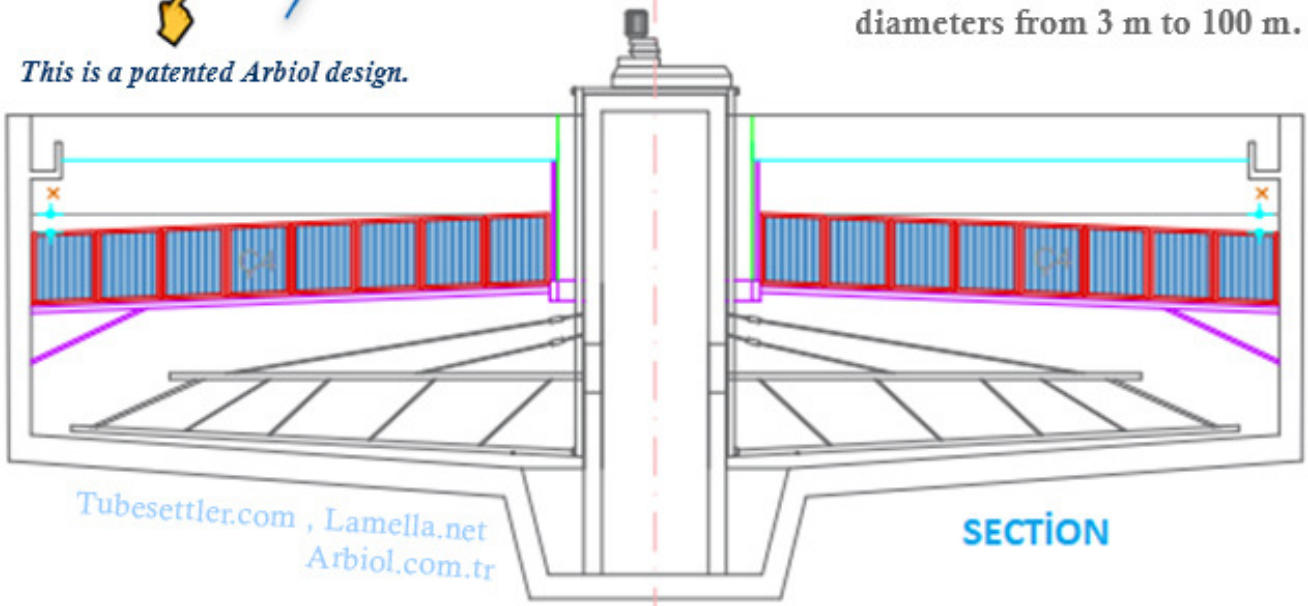
İSKİ-CAAT



PLAN

Tube settler coverage area, suitable for circular basins with diameters from 3 m to 100 m.

This is a patented Arbiol design.



SECTİON

DESIGN-3: Polar Circular Framed-Type Lamella

General Assessment

Framed lamella systems are less commonly used than block types due to the higher frame cost. However, the operational advantages far outweigh the cost.

The special design for circular basins allows the tail of each frame to cover the lower void of the previous frame. Consequently, no dead zones occur in the areas marked “X” on the plan. Continuous, gap-free flow fills the entire basin.
Conclusion: The polar framed lamella is suitable.

Height and Volume Requirements

Specifications require a **minimum lamella vertical height of 1.2 m**. Calculations based on circular framed design:

- Lamella top surface area: ≈ 325 m²
- H = 1.20 m → VL = 325 × 1.2 = 390 m³
- H = 1.50 m → VL = 325 × 1.5 = 488 m³

Conclusion: Volume requirements are satisfied; design is suitable.

Computer-Aided Modeling Results

- Model: **DT56**
- Flow (Q): 2,500 m³/h
- Inclination angle (SA): 60°
- Lamella height (H): 150 cm
- Inclined length (LT): 173 cm
- Critical velocity (HV): 0.4 m/h

Calculated results:

- Lamella volume (V): 494.5 m³
- Required active area (Aa): 6,250 m²
- Active area for DT56: 12.64 m²/m³
- Surface area (A): 329.7 m²
- Surface loading rate: 5.1 m/h (Q/A)

Conclusion: Modeling results confirm suitability.

Maintenance and Service

Framed lamella systems are **easy to maintain**. Lifting devices (mapas) allow simple removal and reinstallation, even without draining the basin. Individual lamella within the frame can be replaced if damaged.

Conclusion: Framed lamella is the most suitable option for maintenance and service.

Final Assessment (DESIGN-3)

- Suitability for circular basin: **Suitable**
- Height & volume requirement: **Suitable**
- Modeling results: **Suitable**
- Maintenance & service: **Suitable**

Comparison Table: DESIGN-1, 2, 3

Criteria / Design	DESIGN-1 (Rectangular Block)	DESIGN-2 (Polar Circular Block)	DESIGN-3 (Polar Circular Framed)
Suitability for circular basin	❌ Not suitable	✅ Suitable	✅ Suitable
Height & volume requirement	❌ Not suitable	✅ Suitable	✅ Suitable
Modeling results	❌ Not suitable	✅ Suitable	✅ Suitable
Maintenance & service	❌ Not suitable	❌ Not suitable	✅ Suitable
Overall Recommendation	Not suitable	Not suitable (maintenance issue)	Most suitable

According to the table, **DESIGN-3 (Polar Circular Framed Lamella)** meets both the technical requirements and maintenance/service ease, making it the **most suitable design for large circular drinking water treatment plants**.