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Smart Prisons And The Ability To Achieve Goals And Standards Of The Facility In Terms Of Raising Its Humanitarian And Security Efficiency

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Abstract

With the fast technological development that occurs at the local and global levels, prison engineering is one of the most important facilities that are mentioned when it comes to applying the latest technologies to provide an integrated internal and external environment with self-control in the presence of security and humanitarian considerations that fulfill the possibility of controlling the facility while providing a suitable internal and external environment for inmates. This is achieved through the smart control of the facility whether at the security or humanitarian level, abiding by the international rules for prisons and human rights requirements, through which we reach smart prisons according to the foundations and standards set in the research.

Keywords: Prison, Smart, Technology, Humanitarian Efficiency, Security Efficiency

1. Introduction

With the current direction at the local and global levels, and focusing on the implementation and application of human rights, especially on punitive facilities (prisons or correctional facilities), which witness significant differences between the past, the present, and the future vision, which differ according to the different cultures of each country. These punitive facilities implement sentences on inmates, besides separating them from society, rehabilitating them, reforming them, and reintegrating them into society after the penalty period [1]. The life of inmates abides by specific standards compared to the civil normal life, and the ability to provide special services to humans as well as respecting all his/her rights in a way that seems as suppressing freedom. In addition to respecting the security and humanitarian rules, where the technological revolution and modern thoughts transform the concept of punishment into a concept of refinement and reform. The current study has a motivation because of the lack of research and guidelines for smart prison architecture. The research aims to reach integrated design standards with a technological impact for prison buildings and achieve the functional needs program for penal institutions within the framework of design considerations and technological determinants as well as change the design thinking of prisons and raise the efficiency of security and humanitarian performance through the application of standards and smart systems to keep pace with developments of this era and technical and technological control in prisons.

McKay, C. (2022) concludes that prisons are on the cusp of technological transformation considering digitization in the twenty-first century. The digitization of prisons and the technological impact benefit the authorities by increasing security and making prisoners benefit from positive opportunities to access justice, which helps in the rehabilitation and reform of inmate. [2], B. Qolomany et al., (2019) said that future buildings will provide new

possibilities of comfort and efficiency for users in terms of integrating and manipulating technological tools in architectural spaces, with a focus on the role of technologies used in automated control within the space. [3], Snyder, R. (2014) said that the goal of prisons is to reduce recidivism, yet the architects ignored this at all and were satisfied with the principle of imprisonment and neglect of this goal, so it was necessary to study the relationship between people and their environment to design prison architecture, taking into account the impact of the environment on the inmates And the study of building patterns and architectural experience and their impact on rehabilitation and repair [4], Villa, B., & Benna, L. (2019) said that the interest in prison engineering, especially in recent times, has a positive impact on the lives of inmates, in addition to reducing the minimum level of security with the possibility of reintegrating detainees into society through the correct use of spaces and spaces.[5], Vessella, L. (2017) said the role of architecture in prison design and how to develop prisons for the possibility of rehabilitation and reform through attempts to break the overall themes that characterize prison construction and interest in contemporary design culture that has a major role on society, especially in penal facilities.[6], Sun, P. (2022) wrote based on the topics related to prison engineering, which is concerned with the Internet of things, smart applications, and smart prison assessment indicators, to reach a clear understanding of prison intelligence and how to consider it as a reference tool within the facility or rehabilitation and reform centers. [7]

2. Technology:

2.1. Concept of Technology:

Several basic concepts are concerned with defining technology, which is a collection and a set of available experiences, knowledge, skills, tools, and means that contribute to human and society purposes.[8]

2.1.1. Definition of Technology:

The word technology is derived from the Latin language. It contains two parts, the first is techno, which means art or movement, and the other part, logia, means study or science. Hence, the term technology contains a set of scientific applications of science and knowledge in all fields.[8]

2.1.2. Characteristics of Technology:

The characteristics of technology can be summarized in certain points as follow:

1- An independent science that has its origins, goals, and theories.
2- A process that affects human life.
3- A process that includes inputs and outputs
4 – An applied science that seeks to apply knowledge.
5- A comprehensive process for all the processes of designing, development, and management.
6 - Dynamic process.
7- A systematic process concerned with the system and its output.
8- It is the means to solve problems. [9]

2.2. Smart Buildings:

The term "smart buildings" has been used for more than two decades to define the concept of network devices and equipment in the building and energy efficiency. In the second half of the seventies the last century, the smart building was a building that was built employing the concept of energy efficiency. In the eighties, the building could be controlled through a home computer, while, today, we use the buildings of the seventies and eighties with the integration of additional sub-systems to manage and control renewable energy sources and home appliances through wireless devices and mobile phones, where the internal and external surroundings can be controlled to achieve the convenience of users. [10]

2.2.1. Basic Techniques of Smart Buildings:

The technologies, used in smart buildings, are among the most important basic elements that contribute to the formation process, which aims to create an interactive environment. These elements come in different forms, namely:

- Automation: the ability to accommodate automatic devices or automated functions of each form.
- Multifunctional: The ability to allow performing more than one function in the building.
- Adaptability**:** the ability to learn, anticipate, and respond to users' needs.
- Interaction: The ability to allow interaction between users.
- Efficiency: the ability to efficiently

save energy, time, and costs. [11]

2.2.2. Components of Smart Buildings:

The smart building contains a set of overlapping elements that contribute to the formation process:

- Sensors - Monitoring and sending data in case of changes.
- Actuators
- Control units (control units and devices based on the programmed rules set by the user).
- Central Unit
- User connection to the system
- Network (allows communication between units)
- The smart meter (communication between the customer and services)
- (Actuators - controllers - central unit) [12].

2.2.3. The Smart Building:

It is a central element in improving cities and infrastructure. However, the comfort of the residents must be improved. It, also, achieves better efficiency in consuming energy, controls safety aspects, and provides a better framework for comfort, quality of life, and services based on the demand of users. It is often known as applications as in the following model (Figure 1). (Systems - for smart management, storage, and analysis of data to facilitate the management, and the possibility of self-control as in the form) as shown in Figure 2 [13].

The current research aims to reach integrated design standards with a technological impact for prison buildings and achieve the functional needs program for penal institutions within the framework of design considerations and technological determinants as well as change the design thinking of prisons and raise the efficiency of security and humanitarian performance through the application of standards and smart systems to keep pace with developments of this era and technical and technological control in prisons.

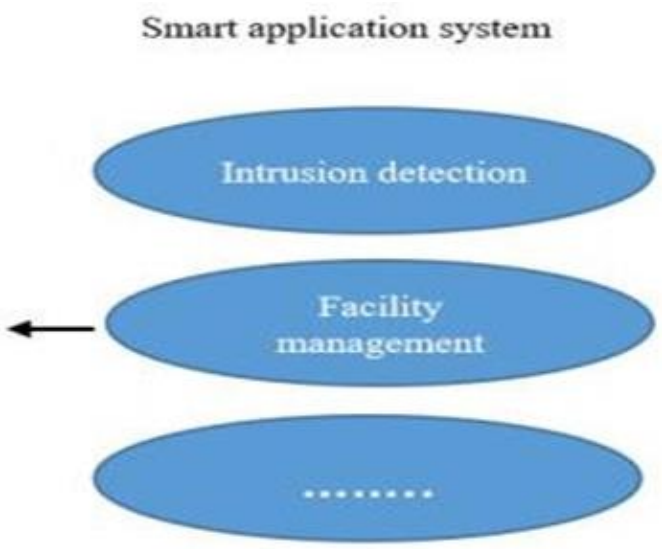


Figure (1) The used smart application

Figure (2) The system used to prepare and data storage

Figure (3) shows examples of sensors, solar devices, power supply systems, sensors (temperature and humidity), and sensors for surveillance cameras, where the central control of these elements can be enhanced via self-control for intelligent management of different sources and multiple structures.[14]

Figure (3) The integration of building devices with sensors

2.2.4. The Advantages of the Smart Building:

Throughout the previous studies based on foundations and standards, it turns out that some technological solutions and innovations work to achieve buildings that have the following:

- Security: Effectively providing the element of security and safety.
- Convenience for users: “smart” homes learn from the behavior of residents and increase their comfort.
- Energy saving: "smart buildings" can significantly reduce energy consumption.
- Time-saving: "Smart buildings" can save a lot of time by automating daily routines.
- Safety: The smart building can detect fire, water, and gas leaks, and warn users of malfunctions or problems.
- Health and Care: the users' health is given the highest priority, which is reflected in (appropriate temperature, the intensity of lighting, and air conditioning...)
- Assistance: (providing a safe and comfortable environment, functional considerations for people with special needs - reducing the feeling of isolation, i.e., it is possible to communicate with other people via the Internet.[15]

2.2.5. The Smart Materials:

Materials that have variable properties, and must reversibly change their shape or color in response to the physical and chemical materials. They are also materials and formations that can respond and adapt externally and internally to environmental stimuli through a combination of functions. These stimuli may be chemical, electrical, or magnetic. [16]

2.2.6. Types of Smart Materials:

The types of materials vary according to the function used and are subject to technological changes. The types of these materials are as follows:

- Electrical rubber materials: These materials are subject to change; they produce an electrical charge when they are mechanically stressed, and generate stress when they are exposed to an electric field.
- Magnetic materials: These materials can change their shape when they are exposed to a magnetic field.
- Electrical materials: change color when an electrical voltage is passed.
- Thermal materials: These are materials whose state changes as a result of a change in temperature or pressure. It resembles the behavior of thick walls, which reduces heat fluctuations to save energy. [17]

2.3. Smart Façade:

Architectural technology helped provide the intellectual and creative needs in the design of building facades with the beginning of the twenty-first century. There are many functions of the smart building facade system such as: enhancing natural light; protection; controlling the sun's glare; isolating sound and noise; providing indoor and outdoor vision; enhancing ventilation; systemizing heat or cold; protecting from pollution; providing security and safety; and protecting from the sun. [18] The correct application of smart materials in architecture may bring real benefits. As scientists claim, the optimal use of smart materials improves energy and material flows, contributes to extending the life of building materials, and makes it possible to create ultra-light and high-strength structures. [19]

2.3.1. Types of Smart Façades:

Many destinations differ according to the nature of the activity and the extent of its use:

- Double facades: This facade is known for its traditional development ability, which is represented by the curtain walls as shown in Figure (4). So, it works against energy loss, sun, and reflection through the use of double-glazed walls. The building consists of a glass exterior facade to provide weather, protection, and sound insulation.
- Interactive facades: This facade radiates either by interacting with external stimuli or by movement, as shown in figure (5).
- Kinetic facade: The kinetic facade is designed as an alternative building envelope as in figure (6), to provide comfort to building users by reducing energy consumption and raising its efficiency. This concept indicates the use of innovative components, complex designs, and advanced technological applications to achieve an appropriate technological environment.[20]

Figure (4) the Double Façade [21]

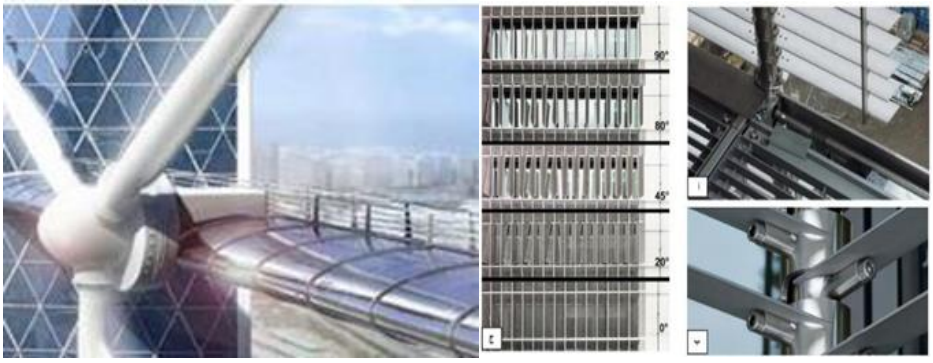


Figure (5) the Kinetic and Interactive Façades [22]

Figure (6) Shows the Materials Used in the interactive facades [23]

2.3.2. Levels of Smart Prison Technologies:

Arranging all smart prison technologies and applications in four ascending levels of information and communication technology, which are as follows:

- Sensor level: "Biometric and environmental sensors, online video surveillance, identification, testing, and GPS as well as power, water, energy, and monitoring"
- Integration level: "Heterogeneous Network Integration, IoT Integration Development Platform, Sensor Integration, Application Services based on Physical System (CPS)"
- Smart level: "big data analysis, computing services, and smart grid"
- Application level: "Connect and extend previously listed layers in a wide range" [24]

2.3.3. The Implementation of Smart Technology:

The devices can be integrated into the smart city ICT platform which is based on IoT for the city architecture model (Figure (7)):

- Sensor networks, applications, services, and tools
- Sensing, data acquisition, and collection
- Data processing and monitoring
- Data integration and management

- Safety deployment and quality control. [25]

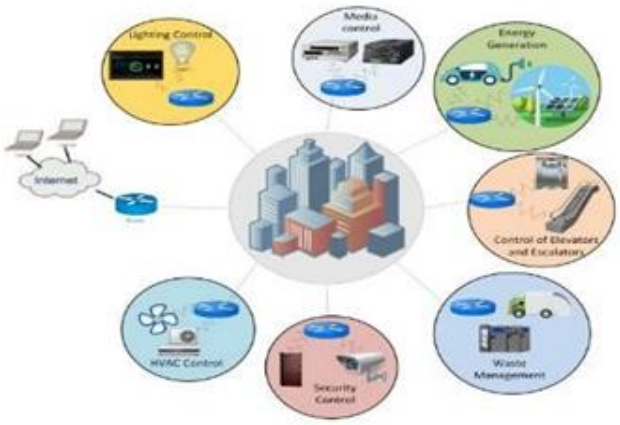


Figure (7) the integration of devices and sensors into one system

3. Prisons:

Prisons are among the special penal facilities for each country, through which they express the extent of countries' culture and technological progress, and to what extent the human dimension is fulfilled within prison spaces following the international foundations and standards set for this.

3.1. The Concept of Prisons:

There are many concepts, but the goal is the same, which is to suppress freedom and enjoyment of human life. There are some concepts regarding prisons: They are institutions dedicated to imprisoning people who have been detained by the judicial authority in the state and deprived of their freedoms after being convicted of a crime. Different terms are used to refer to the places of imprisonment, where people are waiting for their trial, have been sentenced, or are subject to different security conditions inside the buildings. [26][27] (Goffman, 1968) views "prisons" as an example of a complete institution, defined as "a place of residence and work in which a large number of individuals live in the same situation, separated from the broader community for a significant time together leading a closed, formally-managed life cycle". From an architectural perspective. [28]

3.2. The Historical Development of Prisons:

Prisons were used in the sixteenth century as homes to rehabilitate persons who were underage and committed crimes for which the state condemned, as well as places to rehabilitate homeless children in Europe. In the late thirteenth century, governments began to use prisons, due to the decline in the number of trials that ended with a death sentence. They were using prisons as a place to carry out some kind of punishment on criminals. Moreover, construction prisons spread around the world, and the idea of solitary confinement has emerged as a means to rehabilitate prisoners. Then, the means of training and doing business in prison have been adopted as a means to reform them. [29]

3.3. Types of Prisons:

Prisons are designed according to different standards and programs that differ according to the nature and culture of the country. The following types of prisons are significant:

- **Uniform prison system:**

They are prisons that are built as single-complex buildings, where the building includes all the necessary facilities for the prison. They are coordinated harmoniously among them, and this type of prison is used for dangerous prisoners and the prisoners who are sentenced to long-term sentences.

- **Block system prison:**

They are prisons that are built in the form of separate buildings. Each building includes a set of activities, including a kitchen, workshops, and others, where it is easy to access from one building to another. This type of prison is easier to manage and can hold all types of prisoners.

- **Campus system prison:**

A prison is a group of buildings; however, they are not linked to each other by direct relations, as the area of the prison construction site is huge; thus, the buildings are far from each other, and each building has separate functions from the other so that this type of prison is effective to separate the male prisoners and female prisoners from each other in the prison, or in the case of Juvenile Detention prisons whose imprisonment does not require a high level of security. [30]

3.4. The Typical Evolution of Prisons:

Prison patterns differ according to the different eras of time, which differ according to the different ideologies that are followed in that period, and affect the design process. This is what is referred to as the different patterns for each period as shown in figure (8).

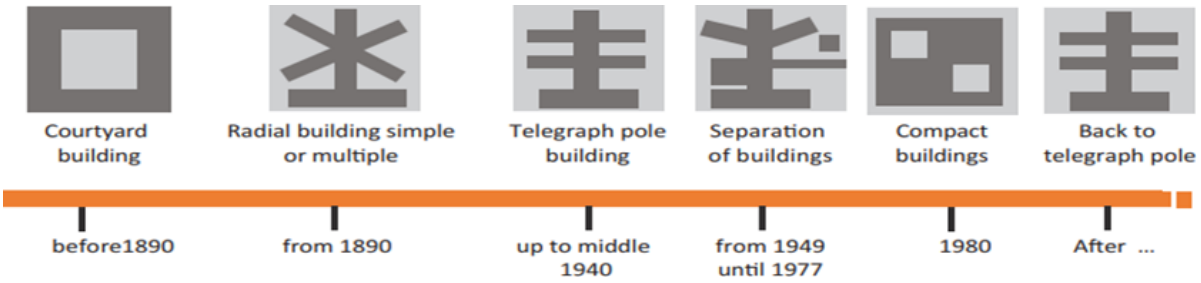


Figure (8) The typical evolution of prison architecture throughout history

Buildings gradually merged with this development. It has led to the emergence of architectural complexes, characterized by the system cell that creates a building with a continuous plan/scheme, arranged in parallel bodies, linked by a central corridor. Thus, it forms closed or open courtyards on one side to bring air and light into the interior, although these complexes were built outside urban areas. [31] The different patterns, in the formation process, play a pivotal role in the success of the design process, and they differ according to the type of prisons, and the policy of the country in which the building is located. [32]

4. Design Determinants of Prison Buildings:

There is a set of determinants that differ in their strength and impact, relying on the circumstances of each society and the extent of its progress. There are social, cultural, and economic constants that have clear impacts on the design process. [34]

4.1. Humanitarian Determinants:

It is one of the most important factors that affect the design process, which is represented in: (the dimensions and minimum limits of the inmate, the physical, mental and psychological needs of the inmate, and other considerations of the inmate's conditions, which differ from one another as well). [35]

4.1.1 Inmate Ratios and Scale:

The ratios related to the inmate play an important role and act as a basic standard in determining the relations between the inmate and the void (space) through the dimensions "length, width, and height". It gives the impression of stability, instability, dread, or other impressions that affect the psychological aspect of the inmate.

Concerning the inmate scale, it represents the relationship between the functional needs of the space so that the vacuum scale is appropriate for the movement of the inmates and their various activities according to the nature of this space as in figure (9), where it is divided into three categories: the human scale - Intimate scale- Monumental Scale. [35]

Figure (9) Monumental, Human, and Intimate Scale [36]

- Human scale: It expresses an increased sensation of block and a decreased sensation of the surrounding details. Its maximum breadth is 52 m, which is the maximum distance to distinguish the movement of the body.
- The Intimate scale: expresses the achievement of inclusion and encourages social harmony and the achievement of privacy, where the surrounding details are manifested, and its width does not exceed 4 m to facilitate

identification of the features of the shapes.

- The Monumental Scale: gives a feeling of awe, fear, and prestige. There is no sense of the surrounding details due to its size, where its width reaches 100 m.

The dimensions of the inmate are represented as a basic standard in identifying each of the dimensions of the spaces and its components and elements and everything that it contains to provide humanitarian comfort for the inmate, taking into account the prisoner's scale in the different spaces within the facilities of the penal institutions in proportion to the type and nature of the activity, and the number of prisoners in the space.

4.1.2. Material and Psychological Needs of the Inmate:

- The inmate has needs and requirements of gradual importance, and vary in importance according to his/her culture, upbringing, and environment, which affect the improvement of his/her behavior during the penalty period, especially the psychological/ moral aspect.
- The material needs are represented in the various jobs that qualify him "healthily, educationally and environmentally." As for the psychological needs, they are the jobs that help in the process of rehabilitation, reform, and change of behavior. This is done by providing places to establish these jobs to achieve human justice following human rights. [37]

4.2. Social Determinants:

The conditions and the nature of the community act as pivotal factors in the design process. If the design does not respond to the given information about the social environment and the cultural environment, it becomes a burden and chaos far from what fits the users of the space. These factors include: (customs, traditions, and religious beliefs). These factors - that differ from one society to another and from time to time – are affected by scientific, technological, and cultural developments. For the inmate, the period of his/her stay in prison depends to a large extent on the psychological impact that he/she is exposed to during that period, so the inmate goes through many phases during his/her sentence, in terms of social relations, social interaction, and reactions, and behaviors, etc. All of these are powerful determinants that affect the design process. [38]

4.3. Environmental Determinants:

The environmental determinants represent a set of physical conditions surrounding the site. so the designer must consider these determinants and must deal with them without changing or ignoring the environmental determinants (location - climate) as shown in figure (10).

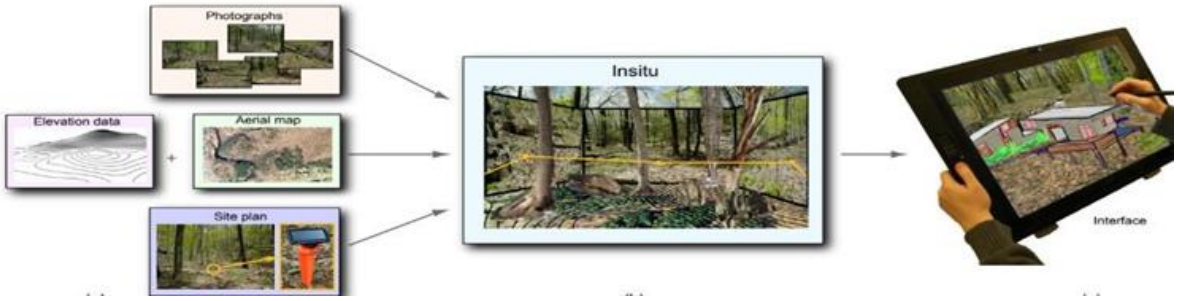


Figure (10) The Environmental Determinants Affecting the Design Process [39]

The impact of the environment on human behavior is noticed in prisons. Psychologists have focused on that. However, the focus was on the elements of "heat, pollution, and noise", and their impact on the behavior of individuals and groups. With the development of some concepts related to the environment and human behavior and the relationship between them, it has been manifested that the concept of the physical environment that affects human behavior does not refer only to the factors such as: "heat, noise, humidity - colors - shapes", but rather the environment is a group of compounds that make up the space or place in which a person resides, interacts and practices his/her activities. [40]

Accordingly, the main axis of the environment and interaction with it makes clear the place and its relation to human behavior, and how individuals perceive and understand the places, needs, expectations, and their various activities.

4.3.1. The Characteristics of the Site:

Each site has its natural features such as topography, which is represented in the formation of the site, plant or water elements, as well as the urban elements that are added by human/individuals such as streets and surrounding buildings, which affect the design process according to its strength, nature, and value (Figure (11)).

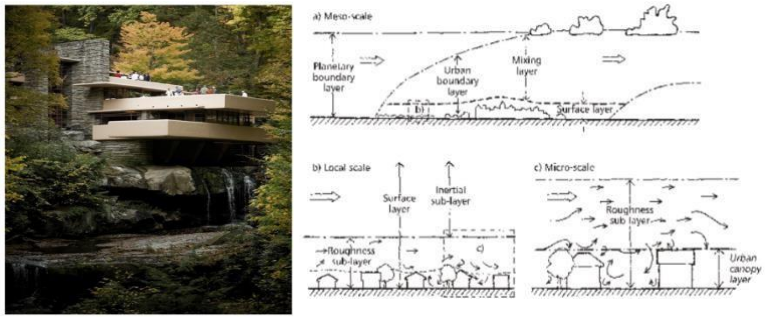


Figure (11) Local construction and its relationship to the surrounding environment

4.3.2. The Climate:

Climate represents the human feeling of heat, humidity, wind, and atmospheric pressure. It is one of the design goals to achieve appropriate climatic comfort within the space. The climatic determinant is of great importance; it affects the feeling of the inmate and achieves environmental and human comfort.

4.4. Design Determinants:

There are foundations for determinants that differ according to the nature and circumstances of each country and from one culture to another, where the design is affected by many factors, including:

- A set of activities that are required to be functionally achieved.
- The desire of the designer or owner (the responsible party) and his/her requirements and special opinions that are imposed to be accomplished.
- The nature of the site, its conditions, and the surrounding area.
- Determining a particular style according to (the site/activity/designer) to express a particular period or civilization. [41]

4.5. Functional Determinants:

Functional determinants play an important role in the design process, which aims to achieve specific needs within the scope of a set of determinants and problems that are solved to achieve the desired function. The success of the design of the inmates' spaces requires achieving the following:

- It should be appropriate for the activities it contains in terms of (spaces, materials, colors, etc.).
- Achieving the requirements of the project (the program), which rules the first lines of the design.
- Achieving the rates set for these projects by previous experiences to ensure the efficient completion of the various activities.

4.6. Aesthetic Determinants:

The aesthetic aspects represent one of the goals that the designer seeks to achieve. However, opinions have differed in determining the meaning of beauty, whether in the simplicity of the design, its complexity, or its clarity, frankness, or strength, but, in general, the aesthetics of the design is one of the determinants that affect thoughts about designing, especially in designing external spaces of prison buildings.

4.7. Economic Determinants:

The economic capabilities represent an important determinant, and a strong influencer on the design work to the extent that it may stand as a barrier in the way of the design thought, or the selection of formations, elements, and materials, which forces the designer to choose alternatives that fit with the available options: (project budget, environmental resources).

- Project budget: It is determined based on the financial capabilities of the competent authorities and the entity of the state. The designer must develop a design and plan that are competent with the budget limitation in a way that hinders the innovative and creative

capabilities of the designer. [42]

- Environmental resources: The environment plays an important role in determining the economic value of the project from several aspects, including raising or reducing construction costs relying on the available natural resources, as well as the location of the project and its natural capabilities and the methods of access, which increases its economic value.

4.8. Technological Determinants:

Technological determinants are among the changing and renewable determinants according to technological development and scientific progress in all fields. It is one of the most important determinants that affect the design and planning thought of different spaces, especially if they are intended for prisoners due to their significant impact on the selection of construction materials, finishes, and treatments in addition to the method of construction and maintenance, and its impact on the design thought in itself so that the final product is not characterized by naivety and stereotyping from the perspective of the inmate. It is to keep pace with the technological and technical development and progress, which would fulfill the health and psychological needs of the prisoner, and develop his/her behavior to be able to encounter future challenges.

4.9. The International Determinants, Agreements, and Recommendations:

International laws and conventions on human rights are binding on all countries; it is a legitimate subject of international laws that must be taken into account in design and implementation considerations, to achieve an effective function that would reform and rehabilitate. They are: [43]

- In the reception area, the data of each inmate is recorded, the inmates are inspected, and the belongings of the prisoners are kept.
- Distribution of spaces according to needs "Separation between categories", where inmates are classified based on gender, age, type of crime, and criminal status, according to whether they are novices or returnees.
- Detention areas are designed according to the design conditions and rules.
- Service areas "food and personal hygiene", which have an effective role in defining the gathering places, and have a clear impact on the design process.
- Sports activities areas are concerned with providing spaces designated for some sports, which help in the rehabilitation and reform process.
- Medical service areas: dispensary clinics or a connection to some hospitals that are affiliated with the region.
- Areas of contact with the external environment “the right to receive visits, the right to be informed of developments in the outside world, to provide prisoners with information, and their right to complain.”
- Places of worshiping: "mosques - churches - temples".
- Providing communication elements at a secure and safe level and with high control over the movement of prisoners from one place to another.
- Areas designated for the work of inmates and teaching crafts “the possibility of working in return for a material wage is one of the rights of the prisoner, under the terms and conditions of work inside the prison.”
- Areas designated for teaching and learning for different levels and the possibility of mending the inmate's behavioral and cultural level.
- Providing places to manage the follow-up to the prison and beyond in terms of monitoring social relations and care after prison “Preparing the inmate to integrate into society after serving the sentence period, i.e., "Correctional programs" approved by international standards "Prisoner rehabilitation program." [27]

5. Principles that affect the Process of prison Designing:

• The scheme of the centrality of radiation on the distribution shaft.
• Flexibility and modularity.
• Safety and control.
• The economics of management.

The development of these principles is the result of the study in the field of prison engineering. Therefore, the proposal seeks to reconcile rational needs and flexibility with the possibility of developing distinct solutions in a typical and specific according to international requirements and conditions. [35]

5.1. Radiation Centralization Diagram on Distribution Shaft:

It is a radiation central scheme on the distribution path. The basic unit of the prototype consists of a holding room - one of the components of the system - which is organized according to a simple and schematic radiation central system diagram.

5.2. Flexibility and Modularity:

- Possibility to develop plans of floors that are flexible, and able to adapt to future needs or the capacity of subsequent extensions identified at the design stage.
- The use of a modular and schematic unit is characterized by a high level of assembly flexibility. It allows the use of construction processes that are based on pre-fabricated systems.

5.3. Safety and Control:

Safety and control include good levels of security, management, and control of the system. The modules are prepared based on a design that relies on simple geometric shapes and repetitive axes, where ease of management and control is ensured by providing distribution shafts (the use of engineering modules) through which various elements can be monitored.

5.4. Managerial Economics:

Among the factors that greatly affect the design process of prisons are: “the costs of construction and management via developing a rational, industrial and modular system” by the use of engineering models. [42]

6. Functional Elements of Prison Designing:

The functional elements differ according to a set of points that must be provided, which contain different functional areas as shown in figure (12) that can be distinguished as follows:

- An area designated for admission, “Registration Desk, Storage Warehouse, and inmates’ belongings”.
- The outpatient clinic area and the dispensary.
- Separate areas and tracks for interviews with relatives, lawyers, and judges.
- Areas designated for inmates' activity: classrooms, library, laboratories, and theatre.
- The areas of main rooms. [43]

Figure (12) Models of Functional Spaces. [44]

Organizing that is based on simple geometric shapes in the functional areas provides various advantages as shown in figure (13).

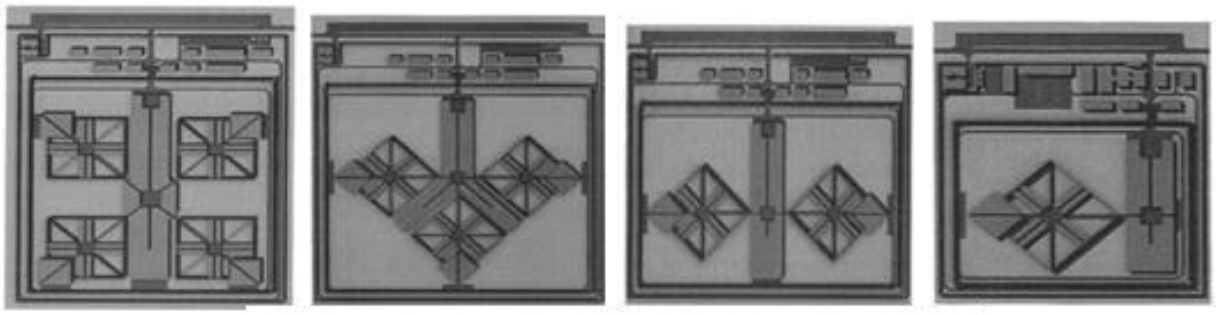


Figure (13) Geometric Shapes with Simplicity of Usage [43]

The two-person room has a bathroom with hot and cold water, artificial ventilation, and a kitchen that allows the portable appliance to cook independently or heat food and wash dishes (Figure (14)).[50]

Figure (14) Models of Functional Spaces. [45]

The room for four has a sleeping area organized into four separate areas, its bathroom, external ventilation with all the usual fittings, a living area with a fully-equipped kitchen, and four beds. The rooms have a balcony overlooking the garden, each detainee has his bed, a Bedside table, and personal shelves.

The area of the room facing outside towards the courtyard contains direct light from the direction of the facade. [45]

7. Components for Building Prisons:

As shown in Table 1 and figure (15)

- Region selection
- The principle of settlement: from prison to reformatory
- Model S.M.E.P: Modular Prison Construction System

Table 1: Analysis of Functional Spaces. [45]

	Inmates Baths
	Personal Toilet
	Entrance
	public spaces
	Staff offices
	Vertical and Horizontal Connection Element
	Gardens / Terraces
	Service Department
	Checkpoint
	Cells

	Residency

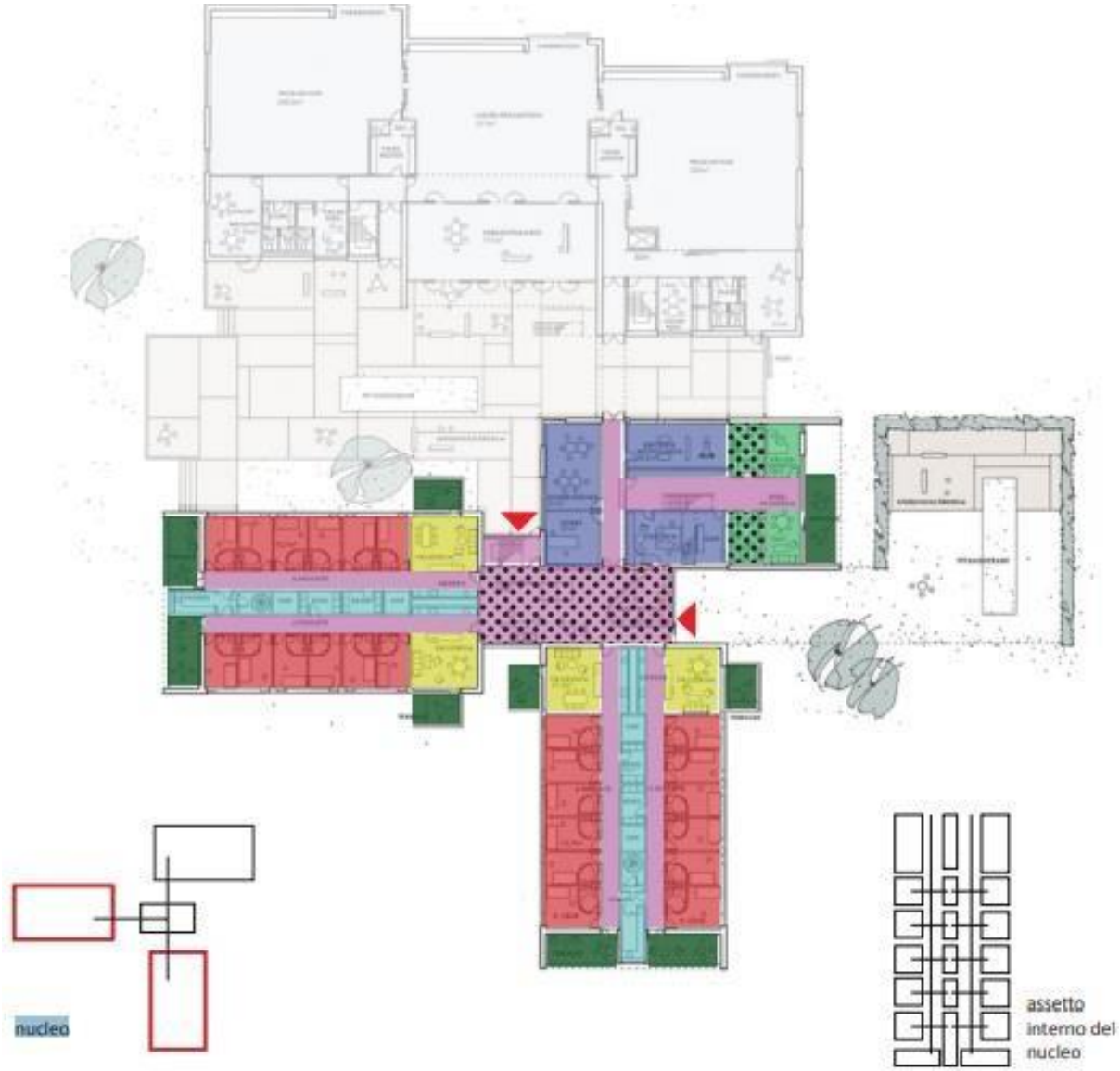


Figure (15) The Analysis of Functional Spaces. [45]

8. International Standards for Human Rights in Prisons:

8.1. The International Rules:

So the prison system to be run fairly and humanely, national legislation, policies, and practices must abide by the international standards that are formulated to protect the human rights of prisoners. While people are detained waiting for trial, or being sentenced to prison, they are deprived of one of the most fundamental human rights. It is the right of freedom of movement and residence. "When the state deprives a person of freedom, it has to care for that person, to preserve the safety of those people who are deprived of their freedom, and to protect the welfare of the individual." [46]

8.1.1. Separation of Categories of Inmates:

The different categories of prisoners are placed in different institutions or different parts of the institutions, taking into account their gender, age, history, reasons for their detention, and requirements for their treatment. Accordingly:

- Men and women are imprisoned, as far as possible, in different institutions, and when there is an institution that receives both sexes, it is a must that the total number of places reserved for women to be completely separate.
- Pretrial detainees are separated from convicted

prisoners.

- Those imprisoned for civil reasons, including debts, are separated from those imprisoned for a criminal offense.

The juveniles are to be separated from adults. [46]

8.1.2. Places of Detention:

- Wherever there are cells or individual rooms for sleeping, no more than one prisoner is to be there in one room at night unless there are exceptional reasons that occur, such as temporary overcrowding. If the central administration of prisons is forced to depart from this rule, it is a must to avoid letting two prisoners be in a cell or a single room.
- When the dormitories are used, they must be occupied by prisoners who are chosen in terms of their ability to socialize in these circumstances, and they must remain at night under constant supervision, by the nature of the institution.
- Provide rooms that are prepared for the use by prisoners, especially bedrooms at night, with all health requirements, taking into account the climatic conditions, especially in terms of air volume, minimum space allocated to each prisoner, lighting, heating, and ventilation. [47]
- The windows should be wide enough to enable prisoners to use natural light to read and work.
- The artificial lighting should be sufficient to enable all prisoners to read and work without tiring their eyes.
- Toilets should be sufficient to enable each prisoner to meet his/her natural needs when necessary and cleanly and decently.
- Facilities of bathing, showering, and washing must be available so that every prisoner is able and obligated to wash at a temperature that fits the weather to the extent required by public health, according to the season and geographical location of the area. At least once a week in a temperate climate.
- All places that are regularly frequented by prisoners in the institution must be fully maintained and cleaned at all times. [48]

9. Functioning Smart Technology in Prisons:

Five dimensions must be achieved before integrating the inmate in prisons for the possibility of achieving and activating the systems used and the possibility of controlling the human aspects that he needs to live in the new environment, which are:

- Using digital resources to overcome social isolation.
- The willingness of imprisoned individuals to live freely in a digital society.
- Digital resources simplify and make working with individual prisoners more efficient
- Recidivism is pursued with the help of digital resources in action for imprisoned individuals
- Security and the need to use digital resources must be balanced. [49]

9.1. Digital Media Technology in Prisons:

It can be summarized according to digital media technologies identified by three main areas of intelligence:

- Technology for surveillance purposes
- Intelligent technology for administrative purposes
- Smart technology is used in the rehabilitation of imprisoned persons (Figure (15)). [50], [50]

Figure (16) The Relation between Technology Used in the City and Prisons [49]

10. The Strategies of Smart Prisons:

Throughout the research study, a design strategy is developed for the engineering of 'smart prisons'. These points are considered among the most important basic elements within the penal facility for the possibility of achieving a comprehensive strategy in smart prisons:

- The comprehensive development of the concept of prisons under the impact of technological factors aims at the integration process of rehabilitation and reform.
- The intelligent transformation of the building and the ability to control it internally and externally.
- Managing daily activities and communications in the prison.
- Opportunities to communicate, learn, and achieve what new technology is trying to support.
- Training on using digital and smart devices for everyone, regardless of their social spaces.
- Designing the system (digital) to support and reinforce the new general concept of prison; is seen as an educational environment for life, without crime, and it follows the overall strategic goals.

This strategy is achieved through the standards and determinants set for prisons, as shown in Table 2.

Table 2: Standards and determinants for prisons

Design Determinants of Prison Buildings	**Standards and Foundations of Prison Designing**
Human Determinants.	Urban Standards
Social Determinants.	Design Standards
Environmental Determinants.	Functional Standards.
Design Determinants.	Psychological Standards.
Functional Determinants.	Economic Standards.
Aesthetic Determinants.	Security standards

Economic Determinants.	
Technological Determinants.	
International Determinants and Strategies.	

This research analyzes and selects the Psychological Standards to focus on. The study of human psychology and the expected behavior within the architectural spaces before starting the design process facilitates reaching solutions to many problems that can occur during dealing with the environment, whatever its form or its function. The human standards are concerned to talk about human behavior within the architectural spaces through the study of human behavior resulting from changing the personal conditions, i.e. the environmental space, and the behavior resulting from the problems faced by man within the architectural space, whether those problems result from his/her failure to reach his/her desired goals within the space. The architectural space, or it is a result of his/her psychological state while presenting the factors that affect the psychological state and the mood of the users in the architectural space, while presenting the human and psychological needs within the architectural space, as the human and psychological needs are considered the basis of human behavior and their relationship to psychological formation is more closely tied compared to the organic formation; as the human being becomes anxious to the lack of his/her physical, human and psychological needs within the architectural space. [53]

The Objective of Psychological Standards in Designing Prisons:

The prison building has a major role in the proper psychological rehabilitation of the prisoner to become a good individual in society, through:

1. Improving the behavior of users through the use of a set of design elements and tools in the design process.
2. Deducing the design effects in the interior spaces that have a role in influencing human behavior.
3. Clarifying the impact of the designer's decisions during the design process of the various interior spaces and their role in the interactive relationship between the elements of the space and the user's behavior. [54]

Through the study and analysis of psychological criteria, a set of points and concepts were revealed to us, from which a set of design principles for prison engineering were derived, as shown in table (3). Through the study and analysis of the design principles derived from psychological standards, design principles with technological impact for prison buildings were produced, as shown in table (4).

Table 3: Points and concepts of psychological standards that affect the design process of prisons

psychological standards	Standard points and concepts for designing prisons	Design principles of prison engineering
	Studying the psychological state of the inmate and determining his/her behavior	• Choosing a suitable place for the psychological/mental examination of the inmate before determining the level of his/her residence. • Collecting and analyzing data concerning the inmate to determine the identity and extent of the inmate's culture and behavior.

	Taking into account the effective humanitarian aspect within the architectural space.	• Determining the different activities of the inmate and allocating him according to the importance of the activity from the psychological perspective. • Choosing suitable relationships for the blocks help in psychological rehabilitation and reduce the fear of the shape of the blocks, such as using containment blocks or repulsive blocks, and this comes according to the extent of the psychological impact on the inmate. • Employing architectural spaces that have human nature and function: "widening spaces that help and stimulate the feeling of freedom", and "high ceilings that help and stimulate deep thinking". • Taking into account, escaping from the “sick building syndrome”. The sick housing factors: (bad ventilation and - lighting, narrow rooms, vestibules or long corridors, and self-restraining design) .
	Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside.	• Using a proper human scale in facades whose nature affects the inmates. • The simplicity of formation and getting out of complications do not cause intimidation for the inmates. • Humanely designing the surrounding walls affects the psychological aspect of the inmate. • Avoid repetition in the process of designing facades. • Using plant elements of human nature in their different colors positively affects the psychological state of the inmate.
	Choosing the proper effective colors in the interior and exterior design elements.	• Choosing the proper effective colors in the interior and exterior design elements. • Distributing the colors of the spaces following the study of the psychological state of the inmate, made by specialists. • Using colors that stimulate activity and growth to help in psychological rehabilitation.

Table 3: Points and concepts of psychological standards that affect the design process of prisons (Continued)

psychological standard	**Standard points and concepts for designing prisons**	**Design principles of prison engineering**
The Psychological Comfort in the Void	Defining the identity of the individual.	• Using the elements of the local environment. • Treatments for vents, windows, and doors.

	Indoor Air Quality in a vacuum.	• Using suitable vents to increase the rate of ventilation. • Limiting pollution sources and reducing emissions.
	Thermal comfort of the space	• Using materials and elements that affect temperature, according to the nature of the place, or based on the surrounding area. • Using vents with a suitable direction for the air to help achieve an appropriate temperature. • Using different plant elements according to the region to help achieve thermal comfort. • Using suitable thermal insulation materials, according to the nature of the area.
	Acoustic comfort in the interior spaces.	• Using noise protection methods: insulators and breakers. • Securing sound insulation for floors, ceilings, and walls.
	Visual comfort in the interior spaces.	• Providing natural and artificial lighting suitable for the nature of the activity. • Determining the appropriate number of vents according to the security conditions. • Using high-impact safety glass to achieve visual comfort.
	The flexibility .of the design	• Increasing the flexibility of the design to provide a sense of satisfaction among the inmates, according to the aforementioned psychological study.
	Privacy	• Providing privacy while increasing the security factor in terms of distributing toilets in invisible places.
	Security	• Achieving safety elements according to the function used with security considerations for each country.

Table (4) Impact of technology on design principles

Psychological standards	**Design principles of prison engineering**	**Technological impact on design principles**
Psychological Rehabilitation of the Inmate (Behaviors)	• Choosing a suitable place for the psychological/mental examination of the inmate before determining the level of his/her residence. • Collecting and analyzing data concerning the inmate to determine the identity and extent of his culture and behavior.	• Defining the “technological room” that contains all of the technological methods through which the psychological dimensions of the inmate and his/her level are determined. • Collecting data resulted from the technological room, analyzing the data, and distributing them in a place that helps in the rehabilitation process.

	• Determining the different activities of the inmate and allocating him/her according to the importance of the activity from the psychological perspective. • Choosing suitable relationships for the blocks help in psychological rehabilitation and reduce the fear of the shape of the blocks, such as using containment blocks or repulsive blocks, and this comes according to the extent of the psychological impact on the inmate. • Employing architectural spaces with human nature and function: "widening spaces that help and stimulate the feeling of freedom", and "high ceilings that help and stimulate deep thinking". • Taking into account, escaping from the “sick building syndrome”. The sick housing factors: (bad ventilation and - lighting, narrow rooms, vestibules or long corridors, and self-restraining design) .	• Self-segmentation of the inmate's identity in the different activities with no human intervention, via data analysis. • Using containment blocks with a technological impact in the linking processes, via opening or closing the paths of movement that lead to other blocks to fulfill social integration between them. • The technological impact of the interior void in terms of the potentiality of the void to fulfill comfort for the inmates "lighting - heat - interior colors" via digital and electronic programs in determining the level of comfort inside the void. • Achieving the interior comfort of the void through integrating the residential requirements alongside the technical requirements such as using special sensors to determine the amount of ventilation and lighting through the vents, and movable facades with no human intervention, and fulfilling the human rights principles.
	• Using a proper human scale in facades whose nature affects the inmates. • The simplicity of formation and getting out of complications do not cause intimidation for the inmates. • Humanely designing the surrounding walls affects the psychological aspect of the inmate. • Avoid repetition in the process of designing facades. • Using plant elements of human nature in their different colors positively affects the psychological state of the inmate.	• Using smart facades with human nature affects the inmates in opening or closing the vision. • Simplicity in shaping with the possibility of technological and automatic control in the outer casing. • Using technological fences with human nature that hinder movement and do not obstruct vision, with electronic control and self-monitoring. • Applying the movable facades, which helps in avoiding repetition and general change of thought related to prisons without intimidation. • Using the elements of site coordination in a technological way, aids in the process of psychological rehabilitation and merging with nature.
	• Distributing the colors of the spaces following the study of the psychological state of the inmate, made by specialists. • Using colors that stimulate activity and growth to help in psychological rehabilitation.	• The possibility of using technological processing, which helps in changing the colors of the room or the internal embodiment of "The hologram". • The possibility of technological intervention in changing colors is based on psychological needs.

Table (4) Impact of technology on design principles (Continued)

Psychological standards	Design principles of prison engineering	Technological impact on design principles

The Psychological Comfort in the Void	●Using the elements of the local environment. ●Treatments of vents, windows, and doors.	●Depending on the elements of the surrounding environment "light - heat - air" under the impact of technology and environmental processes. ● Intelligent "technological" linkage of the openings inside the space to determine the identity and needs of the inmate.
	●Using suitable vents to increase the rate of ventilation. ●Limiting pollution sources and reducing emissions.	●The possibility of technological control in increasing or decreasing the size of the opening as needed. ●Using the elements of the surrounding environment and energy sources to reduce pollution.
	●Using materials and elements that affect temperature, according to the nature of the place, or based on the surrounding area. ●Using vents with a suitable direction for the air to help achieve an appropriate temperature. ●Using different plant elements according to the region to help achieve thermal comfort. ●Using suitable thermal insulation materials, according to the nature of the area.	●The optimal use of the movable facades by sensors that control the opening and the closing of the openings (vents), the required amount of lighting besides the amount of heat, and the integration of the elements of the internal with the external environment to achieve comfort for the inmates.
	●Using noise protection methods: insulators and breakers. ●Securing sound insulation for floors, ceilings, and walls.	●Using mobile breakers that are used in the smart facades to reduce noise pollution. ●Using technological materials that process vacuum spaces to fulfill comfort for the inmates.
	●Providing natural and artificial lighting suitable for the nature of the activity. ●Determining the appropriate number of vents according to the security conditions. ●Using high-impact safety glass to achieve visual comfort.	●Using technological methods integrated with the external facades, and providing complete comfort to the inmates inside the space.
	●Increasing the flexibility of the design to provide a sense of satisfaction among the inmates, according to the aforementioned psychological study.	●Avoiding the complex vacuum spaces, and using spaces that have a significant technological effect, with the possibility of controlling the space and achieving complete comfort for the inmates.
	●Providing privacy while increasing the security factor in terms of distributing toilets in invisible places.	●Using technology to provide privacy within the space, while using all of the elements of interior design that have significant technological impacts.
	●Achieving safety elements according to the function used with security considerations for each country.	●Using security elements with technological effects inside and outside the space, removing the barrier of fear of the penal facility.

11. The Extent of Achieving Security and Human Efficiency in Prisons:

Through the study of the criteria for evaluating prison engineering, the focus was on psychological criteria and came up with help points in the design process to reach techniques with a smart technological impact, which helps in the correct

employment inside prisons and achieve security and humanitarian efficiency.

12. Case study (Halden Prison) [55]:

Opened: April 2010

Location: (Norway) Halden Repairs Complex is located about 100 km Southeast of Oslo.

Figure (17) Halden Prison

- **The Main Objective:**

It is designed to make the prison institution as closely as possible to the outside world, to establish a way of life that is based on responsibility and self-determination as shown in figure (17). [56]

- **The Architectural Description:**
  - The project is one of the most innovative examples in the field of prison engineering for applying the responsibility system. The prison was designed as several separate wards where there are green spaces "the garden" in the middle. The internal movement of the inmates inside the wards is completely free and organizes their recreational activities together.
  - The project contains - 252 inmates, who are busy working or studying activities during the day and spend most of the time outside the detention rooms for rehabilitation the inmates.
  - Designed by studio - HLM arkitektur in collaboration with studio Erik Møller arkitekter. [55]

- **Functional Spaces:**

Each section houses 10 prisoners, in addition to bedrooms, a living room, and a fully equipped dining room (kitchen and multi-purpose room), where inmates can prepare and eat their own (meals) together as well as clean and manage around. The entire area is set within the garden, including trees, seats, and corridors of movement. The inmates visit the garden daily whenever they have free time, in addition to providing workshops and a school. The section, also, includes a studio, and places for guests for relatives who come to visit the inmates. [57]

- **Aesthetic Determinants:**
  - Halden Prison is characterized by the architectural solutions used, where the architects have sought optimal forms and choice of materials as shown in figure (18) to reduce the subsequent effects of incarceration.
  - The prison wall has also been the subject of extensive research, partially obfuscated by its curvilinear layout and tall trees, and the use of murals and graffiti of high aesthetic quality that is painted by contemporary artists.

Figure (18) The level of finishes that are characterized by architectural solutions

- **Economic Determinants:**

Halden Prison was built over ten years at a cost of nearly 200 million Euros, using local environmental resources. [58]

- **Technological Determinants:**
  - Abolishing everything traditional for internal security devices (bars on windows, fences, armored doors, etc.) which have been replaced by technologically-advanced systems that can control internal security without making the inmates feel intimidated in the sense of constriction and alienation.
  - All the elements - described above - contribute to the establishment of a correctional institution concerned with the

human rights of inmates, but freely without technological control.

- Halden Prison is a highly innovative institution for treating and rehabilitating the behavior of inmates. It has its primitive attempts to change the old principles and to abandon the suffering that was considered part of the punishment. [57]

By studying the psychological standards and design principles of prison engineering and coming up with design standards with a technological impact, an analytical study was conducted comparing the principles of prison design and the new principles that have a technological impact on Halden prison as shown in the table (5) and come up with scientific results that keep pace with the technological era of penal facilities with the possibility of raising the efficiency Security and human performance through technological influences on the design process.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
Psychological Rehabilitation of the Inmate (Behaviors)	-Studying the psychological state of the inmate and determining his/her behavior. -Taking into account the effective humanitarian aspect within the architectural space. -Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside. -Choosing the proper effective colors in the interior and exterior design elements.	- Choosing a suitable place for the psychological/mental examination of the inmate before determining the level of his/her residence. - Collecting and analyzing data concerning the inmate to determine the identity and extent of his culture and behavior.	 - Using a humane room used to collect and analyze data by a psychiatrist and an investigator who determine his level of the residence.	-Defining the " technological room" that contains all of the technological methods through which the psychological dimensions of the inmate and his/her level are determined. -Collecting data resulted from the technological room, analyzing the data, and distributing them in a place that help in the rehabilitation process.	 - Using the technological room that contains display screens (visual output device) through which one can analyze the personality from a psychological perspective. - Collecting and analyzing data and determining the level of residence.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
Psychological Rehabilitation of the Inmate (Behaviors)	-Studying the psychological state of the inmate and determining his/her behavior. -Taking into account the effective humanitarian aspect within the architectural space. -Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside. -Choosing the proper effective colors in the interior and exterior design elements.	- Determining the different activities of the inmate and allocate him/her according to the importance of the activity from the psychological perspective. -Choosing suitable relationships for the blocks that help in psychological rehabilitation and reduce the fear of the shape of the blocks, such as using containment blocks or repulsive blocks, and this comes according to the extent of the psychological impact of the inmate.		-Self-segmentation of the inmate's identity in the different activities with no human intervention, via data analysis. -Using containment blocks with a technological impact in the linking processes, via opening or closing the paths of movement that lead to other blocks in order to fulfill social integration between them. -The technological impact of the interior void in terms of the potentiality of the void to fulfill comfort for the inmates "lighting -	 - Using electronic screens that help determine the skill of the activities, and distribute it according to the data analysis.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
Psychological Rehabilitation of the Inmate (Behaviors)	-Studying the psychological state of the inmate and determining his/her behavior. -Taking into account the effective humanitarian aspect within the architectural space. -Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside. -Choosing the proper effective colors in the interior and exterior design elements.	- "widening spaces that help and stimulate the feeling of freedom", and "high ceilings that help and stimulate deep thinking". - Taking into account, escaping from the " sick building syndrome" . The sick housing factors: (bad ventilation and - lighting, narrow rooms, vestibules or long corridors, and self-restraining design).	  	Achieving the interior comfort of the void through integrating the residential requirements alongside the technical requirements such as using special sensors to determine the amount of ventilation and lighting through the vents and movable facades with no human intervention, and fulfilling the human rights principles.	-Block containment has a technological relation, with the potentiality of opening or closing the containment blocks and movement paths utilizing electronic gates with beams to close or open the path.  -The vacuum contains sensors through which it determines the amount of lighting, ventilation, and heat, and the adaptation of the interior space via opening or closing the vents movingly. -Using technological units in the corners of the room to change the colors of the room according to the psychological state by using multi-colored lighting. -Using sensors inside the vacuum to determine the intensity of lighting required for the activity.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
Psychological Rehabilitation of the Inmate (Behaviors)	-Studying the psychological state of the inmate and determining his/her behavior. -Taking into account the effective humanitarian aspect within the architectural space. -Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside. -Choosing the proper effective colors in the interior and exterior design elements.	-Using a proper human scale in facades whose nature affects the inmates. - Simplicity of formation and getting out of complications to not cause intimidation for the inmates. -Designing the surrounding walls in a humane manner that affects the psychological aspect of the inmate. -Avoiding repetition in the process of designing facades. - Using plant elements of a human nature in their different colors that positively affect the psychological state of the inmate.	   	-Using smart facades with human nature that affect the inmates in opening or closing the vision. -Simplicity in shaping with the possibility of technological and automatic control in the outer casing. -Using technological fences with human nature that hinder movement and do not obstruct vision, with electronic control and self-monitoring. -Applying the movable facades, which help in avoiding repetition and general change of thought related to prisons without intimidation. -Using the elements of site coordination in a technological way, aids in the process of psychological rehabilitation and merging with nature	 -using smart facades with a human scale. -Opening and closing the smart facades based on the functional and human needs. - Technological control of the facades electronically.  -Using a closed laser beam in the fences instead of high-rise concrete, and controlling the opening or closing of the circuit. -Removing the barrier of fear between the internal and external communities and nature with the possibility of

					electronic control.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
Psychological Rehabilitation of the Inmate (Behaviors)	-Studying the psychological state of the inmate and determining his/her behavior. -Taking into account the effective humanitarian aspect within the architectural space. -Achieving buildings with aesthetic elements that are safe and comfortable from the inside and outside. -Choosing the proper effective colors in the interior and exterior design elements.	-Distributing the colors of the spaces in accordance with the study of the psychological state of the inmate, made by specialists. - Using colors that stimulate activity and growth to help in psychological rehabilitation.	  	-The possibility of using technological processing, which helps in changing the colors of the room or the internal embodiment "The hologram". -The possibility of technological intervention in changing colors, based on psychological needs.	 -Using electronic green walls increases the rate of green spaces internally and externally, which works to show many types of plants.  -using multi-colored slides in the rooms and changing the colors of the rooms, based on the psychological state.  -Using smart models in various

					activities, and contemporary to the virtual reality.

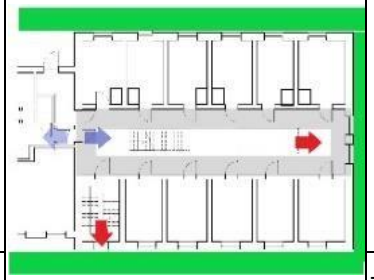
Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
The Psychological Comfort in the Void	- Defining the identity of the individuals - Indoor air quality in a space. - Thermal comfort of the space. - Acoustic comfort in the interior spaces. - Visual comfort in the interior spaces. - Flexibility of the design - Privacy -Security	-Using the elements of the local environment. -Treatments for vents, windows and doors. - Using the elements of the local environment	 	-Depending on the elements of the surrounding environment "light - heat - air" under the impact of technology and environmental processes. -Intelligent "technological" linkage of the openings inside the space to determine the identity and needs of the inmate.	 - Using electronic glass and walls inside the space to determine the needs of the inmate technologically, and to control the inner space by the inmate.  -using movable vents through which the size of the vent can be increased or decreased electronically based on the requirements of the indoor environment and to achieve comfort for the inmate.
		-Using suitable vents to increase the rate of ventilation. -Limiting pollution sources and reducing emissions.		-The possibility of technological control in increasing or decreasing the size of the opening as needed. -Using the elements of the surrounding environment and energy sources to reduce pollution.	 -Using the solar photovoltaic cells to exploit energy sources.

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
The Psychological Comfort in the Void	- Defining the identity of the individuals - Indoor air quality in a space. - Thermal comfort of the space. - Acoustic comfort in the interior spaces. - Visual comfort in the interior spaces. - Flexibility of the design - Privacy -Security	-Use materials and elements that affect temperature, according to the nature of the place, or based on the surrounding area. - Use vents with a suitable direction for the air to help achieve an appropriate temperature. - Using different plant elements according to the region to help achieve thermal comfort.	   	- The optimal use of the movable facades by sensors that control the opening and the closing of the openings, the required amount of lighting beside the amount of heat, and the integration of the elements of the internal with the external environment to achieve comfort for the inmates.	 - Using movable facades by the internal sensors automatically to provide ventilation, lighting, and appropriate temperature to fulfill comfort for the inmates.  -use smart facades as movable refractors to reduce direct radiation, based on the needs of the inmates.
		-Use suitable thermal insulation materials, according to the nature of the area. -Use materials and elements that affect temperature, according to the nature of the place, or based on the surrounding area. -Use suitable thermal insulation materials, according to the nature of the area.			

Table (5) A comparative analytical study of Halden Prison before and after the technological impact (Continued)

Psychological Standards	Standard Points and Concepts for Designing Prisons	Design principles of prison engineering	The Current State of Halden Prison	Technological Impact on Design Principles	Technological Impact on Halden Prison
The Psychological Comfort in the Void	- Defining the identity of the individuals - Indoor air quality in a space. - Thermal comfort of the space. - Acoustic comfort in the interior spaces. - Visual comfort in the interior spaces. - Flexibility of the design - Privacy -Security	-Using noise protection methods: insulators and breakers. -Securing sound insulation for floors, ceilings, and walls.		-Using mobile breakers that are used in the smart facades to reduce noise pollution. -Using technological materials that process vacuum spaces to fulfill comfort for the inmates.	
		- Providing natural and artificial lighting suitable for the nature of the activity. - Determining the appropriate number of vents according to the security conditions. -Using high-impact safety glass to achieve visual comfort.		- Using technological methods integrated with the external facades, and providing complete comfort to the inmates inside the space.	-Integrating internal and external sensors to achieve a compatible environment technologically. 
		-Increasing the flexibility of the design to provide a sense of satisfaction among the inmates, according to the aforementioned psychological study.		-Avoiding the complex vacuum spaces, and using spaces that have a significant technological effect, with the possibility of controlling the space and achieving complete comfort for the inmates.	-Employing smart technology to achieve flexible and simple spaces, where technology is easy to apply: “using 'laser columns' instead of 'armored doors', and the 'electronic monitoring system' (EMS) instead of the 'personal monitoring' to achieve privacy for the inmate.
		-Providing privacy while increasing the security factor in terms of distributing toilets in invisible places. -Achieving safety elements		-Using technology to provide privacy within the space, while using all the elements of interior design that have significant technological	

		according to the function used with security considerations for each country.		impacts. -Using security elements with technological effects inside and outside the space, removing the barrier of fear of the penal facility.	 - The proper functioning of furniture elements, and the possibility of integrating technology within the space in terms of providing privacy, or achieving all the requirements of the inmates through employing smart technology. - Controlling the opening or closing of the openings (hatches) electronically via the security services after making sure of all the security considerations.

13. Results and Findings:

Through the previous comparison, it was concluded that the technological impact on prison buildings is one of the most important future and international requirements, standards and requirements to raise the efficiency of security performance and access to humane smart prisons to achieve complete comfort for inmates inside penal facilities, based on the conducted study, the following can be withdrawn:

1. Halden Prison is one of the most humane prisons in the world, but there is a technological defect in architectural terms to keep pace with the era of technology and modern developments.
2. The Critical interpretation of concepts, design elements, and approaches that are related to the subject of reformist architecture, i.e., an attempt to mend the relationship between the theoretical concept and the actual practice of prison construction.
3. The idea of the project and the architectural design when it is fulfilled in the structure of the building is the physical expression of a summary and a specific vision of the world. It is manifested through the architectural consistency of the building and the built spaces, and the use of smart technology in creating an interactive environment.
4. Prison is what represents the gap between theoretical thought and tangible results over the past forty years.
5. The idea of raising the efficiency of security performance: This approach is heading towards more security, more technologies, and more complex operating procedures.
6. Intelligent prison building is the frequent update of information prisons, and pays more attention to data management, and integration of smart systems:
    - Strengthening and reinforcing monitoring and prison security risks such as barriers to early warning.
    - Enhancing emergency fences to be smart, efficient, and strong.
    - Building inclusive and intelligent governance (the prison mind).
7. Rebuilding the unified working mechanism for the digital transformation of prisons.
8. Activating the comprehensive data building plan in the smart prison:
    - Data collection.
    - Prison side (local data storage).
    - The prison administration aspect (huge data storage and analysis plan).
    - Analysis (smart multidimensional analysis and standards).
9. Smart prisons are used to measure achievement on four levels of goals:
    - Surveillance, security, and law.
    - Rescue criteria.
    - Quality of correction.
    - Improving efficiency.
10. Smart Prison Features:
    - Smart security (integrated interconnection system).
    - Smart governance (free access system, office platform, and website).
    - Intelligent correction (supervision of online positioning).
    - Implementing the smart law (fairly activating the penalty).

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