

Local Government Institution of Culture – Centre for Modernity Mill of Knowledge
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DETAILED DESCRIPTION OF THE CONTRACT SUBJECT-MATTER

EXPOSITION “THE FOUCAULT PENDULUM”

PART I – GENERAL REQUIREMENTS

1 Basic information

Centre for Modernity Mill of Knowledge is a local government institution of culture established by the municipality of the City of Toruń. It shall be located in two historic buildings in so-called pre-war Richter Mills on their first 6 storeys. Two remaining floors of the building where the exhibitions shall be located are designed for another institution. Location of the Centre in Toruń and in historic buildings shall determine the nature of permanent exhibitions presented: “On the Revolutions,” “The River,” “Power and Energy,” “Ideas”.

The exposition “Foucault Pendulum” (hereinafter Exposition) shall consist of a Foucault Pendulum with a accordingly arranged space under and around the exhibit and a multimedia site associated with the exhibit in terms of the subject matter and will be the central, largest and most spectacular exhibit of the Centre for Modernity Mill of Knowledge. The Foucault Pendulum, along with a accordingly arranged space under and around it, will be visible from all storeys of the building, where it will be located. The floors from one to five inclusive shall comprise open viewing galleries, while the other two levels will not enable the Foucault Pendulum motion observation. The Exposition shall also include a multimedia site, referring to the subject of the exhibit, which will be located on the first floor in the immediate vicinity of the viewing gallery. The Exposition will be part of a larger exhibition with the working title “On the Revolutions,” located on the ground floor and first floor of the building.

1.1 Exposition audience

The Exposition is aimed at individuals and organized groups:

- Children and adolescents
- Adults and full families.

Children under 12 years of age will have to visit the Centre for Modernity Mill of Knowledge under adult supervision. Organized groups will visit the Centre for Modernity Mill of Knowledge only with carers.

1.2 Exposition components

The Exposition shall consist of the following components:

- **The exhibit of Foucault Pendulum**, along with mounting system, including necessary structural components, and motion induction system
- **Arrangement of space under the Pendulum and around it**, allowing for quantitative and qualitative observation of changes in the Pendulum plane of vibration
- **Educational site with multimedia presentations**, related to the inertial forces in non-inertial frames of reference and their influence on natural phenomena and the Foucault Pendulum motion.

1.3 Exposition specification

The main idea of the Exposition is to introduce the audience with the experiment that demonstrates the revolution of the Earth around its axis. Deviation of the plane of the Foucault Pendulum oscillation from the original position is an effect of the Coriolis force – one of the inertia forces active in a rotating frame of reference, which is the Earth.

For the first time, this experiment was shown under the dome of the Pantheon in Paris, on 26th of March 1851, when Jean Bernard Leon Foucault, using self-made pendulum, proved that the Earth revolves. Brilliant in its simplicity, the idea of his experiment was based on the assumption that, sufficiently long and heavy pendulum should be taken, its motion would be approximately harmonic and would allow for observation of deviation of the pendulum oscillation plane from its original position due to the fact that it takes place in a rotating frame of reference associated with the Earth. Hence, we observe an effect of fictitious forces, including the Coriolis force. Foucault device consisted of pendulum featuring length of 67 meters and 28 kg cannonball. The pendulum was set in motion by burning the thread attached to the surface. During the experiment, the pendulum oscillation plane changed, and a longer observation proved that the heart of the pendulum moves leaving a mark of rosette. Azimuthal angle indicating position of the pendulum vibration plane at the moment relative to the oscillation plane from the beginning of the experiment, changed at a constant speed equal to the angular velocity of the Earth rotation. Full rosette was marked as soon as the Earth made a full revolution. The show impressed the audience so much that similar pendulums began to appear in various places of the world.

Toruń Foucault Pendulum with the motion induction system shall be placed in a cone running through 8 storeys of the building, crowned with glass dome on the roof on a structure specially developed. The Pendulum motion will be visible from all floors of the building, from open galleries or through picture windows. The Pendulum length shall meet the requirement of the Pendulum heart motion taking place directly above the basin on the ground floor level, while the mass of the entire system will allow minimizing the damping impact on the Pendulum motion. The arrangement of space under the Pendulum and around it shall include:

- The basin under the Pendulum with surface enabling visualization of changes in the Pendulum oscillation plane
- The wall of the lobby behind the Pendulum.

In the immediate vicinity of the Exposition on the ground floor level, there will be the main lobby of the Centre for Modernity Mill of Knowledge.

Around the lobby, directly next to the main entrance, there will be cash and information desks located, and on the right and left sides of the lobby there will be cloakrooms, restrooms and service room designed for a little shop. On the first floor level, in the vicinity of the viewing gallery, there will be the educational site with multimedia presentations, referring to the subject of the exhibit of the Foucault Pendulum. On the ground floor, in the immediate vicinity of the exhibit of the Foucault Pendulum, there will be an exposition message encouraging performing the experiment observation.

1.4 Technical description of the building

1.4.1 The building

Ultimately, the Centre for Modernity Mill of Knowledge shall be located in the buildings of mill and grain elevator under conversion, originating in the 1940s, which are located at streets Łokietka 5 and Dworcowa 8-10 in Toruń. The building consists of two main functional parts, which will be used by two different owners: Centre for Modernity Mill of Knowledge and Technological Incubator of Toruń. For the Centre of the art Mill Knowledge, there is seven-storey exhibition space designed (the building of the former elevators – building “E”, see section T_A_W_P_01, axis 7-10) and the scientific labs for the general public (in a part of the former grain mill – building “D”, see section T_A_W_P_01, axis 1-6) separated by communication zone (two stairways and lift unit). Technological Incubator of Toruń is to occupy the uppermost eighth storey of elevator part (building “E”) and two uppermost levels of the mill (building “D”). Third floor has a double height.

In the ground part, the building is based on the shape of a rectangle with sides of 29.6 m and 37.3 m. It uses reinforced concrete framing. It is supported on reinforced concrete columns featuring rectangular cross section and transverse dimensions various on individual floors. Horizontally, at the level of ceilings, between the columns, stretch joists with distinctive change (increase) of height at the supports. The deck panel with reinforcement features a thickness of 12 cm, 15 cm on the flat roof. Roof panel featuring thickness of 15 cm is provided to transfer loads from air conditioning equipment. On the roof panel, above a number of holes, there is a steel structure turret provided. The ceiling operational load in the exhibition part amounts to 5.0 kN/m², while in the roof section – 3.0 kN/m². External doorway leading to the main lobby features dimensions of 216.5 cm width and 250 cm high; it is followed by another doorway, 195 cm wide and 250 cm high.

The scheduled Foucault Pendulum Exposition will be located in the exhibition space (building “E”) consisting of mezzanines opening towards the cone interior outlined by a plane parallel to the Pendulum motion plane. In this way, the Foucault Pendulum Exposition will pass through the entire height of the eight-storey building. The Pendulum shall be suspended at the top of the glass lantern protruding beyond the roof – viewing terrace. The first level shall be open in such a way that the visitor upon entering the building will have a view of the Pendulum.

1.4.2 The exhibition space

The Foucault Pendulum will be placed above the floor in a designated area of circular shape. The radius of the Pendulum zone on the ground floor is 4 m, while the surface is 52.42 m². In this place, there is a hollow (basin) in the floor at depth of 0.60 m, surrounded by a balustrade of laminated glass with a handrail at a height of 1.10 m above the floor forming the safety zone. The entrance to the safety zone featuring a width of about 1 m provided from the south wall (see the ground floor plan T_A_W_R_01). The height between the floor and the turret top, where the Pendulum is to be suspended, amounts to total of 34.10 m, but due to the finishing and arrangement works, that height is subject to slight change.

The space for the Foucault Pendulum is open for the first six levels from the ground floor. On the sixth and seventh floors, the Pendulum zone is separated from adjacent rooms with a chute in the system of stretch membranes Extenzo Iceberg 33003. The enclosure of this zone is made of bricks on cement-lime mortar and gypsum boards Rigips Reflex for radius curved walls, the total thickness of 22.5 cm (see section T_A_W_P_01). At level +8 (roof) installed glass platform of hardened laminated glass featuring a thickness of 4 cm mounted to the steel structure. Above it, from two sides there is a penetration of dimensions 150 × 40 cm, where a pipe featuring diameter of 25 cm and a length of 40 cm is located (see the 8th floor plan T_A_W_R_09).

The steel structure for assembly of the Foucault Pendulum should be made in such a way that the total length of the Pendulum was as high as possible, 33 m at least. The structure should be anchored to the flat roof so as to ensure safe and correct operation of the Foucault Pendulum Exposition. Details concerning the implementation of the skylight glass casing above the Pendulum are presented on vertical and horizontal sections T_A_W_D_09_A-C.

In addition, the Contractor agrees to ensure that the Employer shall not lose the guarantee of the General Contractor of construction works or that the Contractor shall provide guarantees for works completed, related to breach of works already completed, for a period of not less than the guarantee provided by the General Contractor. All costs associated with such a change are on the Contractor's account.

In the event that floor, steel structure and/or other finishing works are implemented at the same time when the Contractor install the sites, the Contractor is obliged to do so with approval of the General Contractor of construction works in a manner that ensures safe operation and proper aesthetics. All costs involved are on the Contractor's account. In the event that the Contract subject is implemented after completion of the construction works, then the Contractor is obligated to fulfil all necessary engineering processes related to foundation of the Foucault Pendulum Exposition and to restore the original state, or another conditions providing aesthetics and safe use.

1.4.3 Media

1.4.3.1 Electrical systems

The internal electrical system shall run on the walls of the safety zone in the hollow of the floor in four locations where sockets 2P+Z 230V will be mounted (see the arrangement of sockets plan R_01). In addition, on the ground floor there will be power supply on the wall situated from the south and on reinforced concrete columns from the north-east and north-west and in adjacent rooms. On higher storeys, in rooms designed for the Exposition and workshops there is scheduled installation of floor sockets powered from the rooms below (an example installation of sockets on the 1st floor plan R_03).

General electrical sockets mounted at a height of 0.3 m, industrial sockets 400V at a height of 0.5 m, while in the bathrooms and utility rooms at a height of 1.1 m with buffer zones of 60 cm from the edge of the tub or shower. The circuits of sockets are protected with residual current circuit breakers ($\Delta I = 30 \text{ mA}$).

1.4.3.2 Lighting

In the exhibition space and on the ground floor of the building, the lighting level at the working plane shall be provided, i.e. at a height of 0.85 m from the floor level, featuring illumination of about 400 lx (see the lighting system plan R_02). There is also designed a backlight of the skylight structure above the Pendulum zone and on the sixth floor in the chute separating the Pendulum zone from other rooms by means of modular-linear floodlights LED RGB mounted in the skylight structure (see the lighting system plan R_18). In addition, the building shall also feature low illumination LED emergency lighting.

1.4.3.3 Water and sanitary systems

The Foucault Pendulum Exposition area does not comprise water intakes, but ones are located in adjacent rooms on the ground floor in the main lobby. The power supply horizontal cables shall run under the ceiling and in the space under the ground level floor, from where the nodes out to risers shall be conducted. The power supply vertical cables shall run through installation shafts or enclosed wall trenches along with the hot water supply system and air circulation air circulation.

1.4.3.4 Ventilations and air conditioning

Mechanical intake and exhaust ventilation with air-conditioning of rooms. The core of the system shall consist of three roof ventilation units and one suspended unit in the attic, which shall direct the external air to relevant rooms. The ventilation system for the entire exhibition space has been designed as a laminar flow system using base displacement supply diffusers. Such a system is designed to eliminate the influence of ventilation air motion on the Pendulum operation.

Ceiling and wall mounted air conditioners Fan-Coil featuring a functionality of air cooling shall be used in office rooms, conference rooms and computer rooms. The server rooms shall be equipped with an internal air cooling system using Freon systems.

1.4.4 The building shall also include the following equipment, systems and devices:

- Fire alarm system
- Audible warning system
- Automation system of ventilation and building management
- Telecommunication system for intrusion detection system, access control, CCTV
- structural network system (computers, telephones, network equipment and telephone exchange)

There is also scheduled a distribution of WiFi network available in the building excluding the exhibition rooms (exhibition space) through the use of overhead Access Points.

It is required that network devices comply with the communication protocol IPv6.

1.4.5 Conditions of works course in the building

Scheduled date of works completion, of the entire investment, is November 2012.

Installation of the flat roof (layers of roofing paper, styrodur, separation layer, and pebbles) in building "E" is scheduled until May 2012. The system suspended ceilings on level +1 shall be installed up to July 2012, while all of these works on other floors is scheduled until mid October 2012. Finishing of granite subfloors is scheduled for July 2012. Installation works related to electrical and telecommunication systems in the exhibition part are expected to last until October 2012. These terms are prognoses only and are subject to change.

When developing the Foucault Pendulum Exposition, the Contractor shall in no way affect the design, structure, systems, arrangement and finishing works completes thus far, etc., or execute other works that could in any way violate the conditions of the guarantee provided by the General Contractor of construction works named Pol-Aqua, or otherwise compromise the standard of the building. In case any changes to the Investment Detailed Design are necessary, the Contractor is obliged to agree upon them in advance with the Investor, i.e. the Municipality of the City of Toruń and obtain a written consent of the General Contractor and the Design Supervision to any interference and/or change. Any and all costs involved are on the Contractor's account. Also, any changes of designs, even if necessary for the implementation of the Contract subject, shall be on account of the Contractor, who agrees to incur all the costs involved. The Contractor is responsible for any damage that may possibly arise during the implementation of the Contract subject, even if revealed at a later date, but were resulted from the Contractor's activities. When delivering the Contract subject the Contractor is obliged to implement it in accordance with Polish regulations, including those related to fire protection and safe use of the building, H&S rules and standards. During the period of the Contract implementation the Contractor agrees to cooperate with the General Contractor of

construction works and other contractors who will perform subcontracted works at the construction site. Until the completion of the works by the General Contractor, the Contractor's employees are responsible to the management of the construction site with regard to H&S and fire protection issues. Prior to commencing the Foucault Pendulum Exposition, the Contractor is obliged to verify all necessary measurements in real world.

2 Description of the Contract subject matter

2.1 Designs

2.1.1 Develop and provide the Employer with graphic and detailed designs of individual components of the Exposition, in particular:

2.1.1.1 Foucault Pendulum design with the suspension system and the structure for suspend the Pendulum and the motion sustainment system, including, in particular, the following specifications: technical drawings of individual parts, description of motion sustainment system with necessary calculations, description of the suspension system with necessary calculations, the mass of the Pendulum heart and of the Pendulum as a whole, the amplitude of the Pendulum oscillations, the period of the Pendulum oscillation, the frequency of the Pendulum revolution and the logarithmic decrement of not excited Pendulum vibration damping.

2.1.1.2 Design of the educational site with multimedia presentations, related to the inertial forces in non-inertial frames of reference and their influence on natural phenomena and the Foucault Pendulum motion.

2.1.2 Develop and provide the Employer with graphic design of the Exposition space arrangement, in particular:

2.1.2.1 Design of management of the basin under the pendulum with visualization and description of method of illustration of changes in the vibration plane of the Foucault Pendulum

2.1.2.2 Design of the Pendulum wall arrangement including visualization.

2.1.3 Develop and deliver updated visualizations of components and the whole Exposition, showing the Exposition of each side, day and night times, based on the designs referred to in Sections 2.1.1 and 2.1.2, following the final acceptance by the Employer:

2.1.3.1 in electronic form featuring parameters enabling production of a print of size 0.7 m × 0.5 m, without compromising their quality. The files prepared must hold appropriate parameters providing clear and accurate picture when printed. Required parameters: CMYK colour, resolution min. 300 dpi in 1:1 scale, files saved as "tif" in 1:1 scale

2.1.3.2 in the form of overprint on PVC board sized 0.7 m × 0.5 m for three visualizations selected by the Employer from among electronic visualizations provided by the Contractor.

2.1.4 Create and provide the Employer with a graphic design of the Exposition message for the the exhibit of the Foucault Pendulum, comprising the following:

- a. The exhibit name in Polish and English
- b. Guidelines for the visitors regarding observation of changes in the vibration plane of the Foucault Pendulum in Polish and English
- c. Description of the phenomenon presented in Polish and English.

2.1.5 Develop and provide the Employer with a design of all presentations meant for the multimedia site. In particular, the design must include the following:

- a. A list of all presentations, including specifications of their contents and a list of means of multimedia communication
- b. Graphic designs of the presentations

- c. A sample of a video for use in a presentation
- d. A sample of animation for use in a presentation
- e. The structure of the entire multimedia software detailing the transitions between subsequent presentations.

2.1.6 Provide the Employer with an estimate including prices of Exposition components, listed in Section 1.2 and all other expenses necessary for the implementation of the Contract subject (following the final acceptance of the designs by the Employer).

2.2 Exposition implementation

2.2.1 Complete all components of the Exposition as per designs listed in Section 2.1, with necessary tests, accepted by the Employer.

2.2.2 Delivery, installation, commissioning and integration of the Exposition components.

2.2.3 Test in the presence of the Employer representatives all Exposition components and, based on the test results, introduce necessary changes.

2.2.4 Delivery of spare parts that can be used for repairs (referred to in Section 2.3.1), carried out during the guarantee period by trained employees of the Employer.

2.2.5 Delivery of all consumables for individual components of the Exposition for the initial year of its presentation, from the date when it is accepted by the Employer, Centre for Modernity Mill of Knowledge.

2.2.6 Create, deliver and locate in the Exposition area an Exposition message for the Foucault Pendulum exhibit, developed as per design listed in Section 2.1.4 approved by the Employer and provide the Employer with the message on a CD or DVD, in an electronic form that allows any modifications.

2.2.7 Create and provide the Employer with fully functional multimedia site software with animations, videos and other interactive software deployed, according listed in Section 2.1 approved by the Employer, in a form that allows software changes as well as adding new videos and animations. In particular, the Contractor shall provide the following:

- a. A list of all presentations, including specifications of their contents
- b. Graphic designs of the presentations
- c. All animations used in electronic form on a CD or DVD
- d. All videos used in electronic form on a CD or DVD
- e. All computer programs developed for presentation in electronic form on a CD or DVD
- f. All other presentation components produced using means of multimedia communication in electronic form on a CD or DVD
- g. The structure of the entire multimedia software detailing the transitions between subsequent presentations.

2.3 Documentation and the personnel training

2.3.1 Create and provide the Employer with documentation of the Exposition containing at least the following information (as-built documentation):

- A. The Exposition name
- B. The Exposition purpose
- C. The Exposition list of components
- D. Graphic and detailed designs of the Exposition and its individual components
- E. Detailed method of operation of individual components of the Exposition

F. Detailed information on the media and consumables necessary for proper operation of the Exposition components

G. A list of repairs that may be performed by the personnel of the Centre for Modernity Mill of Knowledge trained by the Contractor during the guarantee period, without compromising the guarantee conditions.

2.3.2 Create and provide Employer with manuals, rules of control, service and maintenance of individual Exposition components in Polish as a hard copy and electronic form as well as the guarantee cards.

2.3.3 Handover to the Employer of the test results referred to in Section 2.2.3.

2.3.4 Transfer onto the Employer of software licenses and copyrights for the photos, graphics, drawings, fragments of source texts, videos and animations, and other software and works used in all Exposition components.

2.3.5 Handover to the Employer of declaration of conformity of the Contract subject with applicable regulations and standards; the components of the Exposition and arrangement must conform to European safety standards and have attached declarations of conformity proven by CE marks.

2.3.6 Transfer onto the Employer of copyrights for the Contract subjects under the conditions specified in the Contract.

2.3.7 Training of Centre for Modernity Mill of Knowledge for the operation, control, maintenance and service of the Exposition components, produced by the Contractor, to the extent enabling the employees to perform repairs (referred to in Section 2.3.1 G), also during the guarantee period. Training for a group of up to 10 persons shall be carried out at the premises of the Employer in Polish or English. The Contractor shall propose the training duration in the schedule.

3 The Employer requirements regarding the Contract subject matter

3.1 General requirements

The design concept should be consistently applied throughout the Exposition space and include design of the Exposition components and spatial arrangement, consider the nature of the Exposition message and graphic development of the multimedia site presentations. The design solutions applied and the arrangement components should not hinder the visitors from accessing the Foucault Pendulum exhibit and the multimedia site. Neither, should they interfere with the educational communication.

The Employer requires that the design convention and the Exposition arrangement:

- are consistent and colours are consistently used throughout the entire arrangement
- are not monotonous nor too provocative
- include no aggressive themes
- provide information and provoke visitors' thoughts on the experiment presented, for instance through taking account of the historical background of Foucault Pendulum exhibit or themes of mathematics, geometry, related to the pendulum motion and forming their artistic conversion.

The Exposition must be arranged so that the communication solutions do not interfere with the freedom of access to the components for both fully fit persons and the disabled. The arrangement should consider the accessibility for both single persons and groups, ensuring passable halls and corridors throughout the Exposition area.

3.2 The requirements for the Exposition contents, animations, multimedia presentations, videos and Exposition messages

3.2.1 The exhibit of Foucault Pendulum must have attached an Exposition message, embedded in the surroundings of the Pendulum, whereas the multimedia site should include appropriately selected multimedia presentations. The message and multimedia presentations must be consistent in terms of content and graphic solutions, have a distinctive appearance consistent with the arrangement concept established. The Exposition message must be attached in such a way as to be visible to the visitors. The Employer allows the possibility of changing the message content at a later period of operation; hence it must be constructed in such a way that the replacement does not cause interference in the site. The Employer requires the Contractor to submit the Exposition message also in electronic version, enabling the content modifications.

3.2.2 The contents of the Exposition message, animations, videos and multimedia presentations must contain scientific and educational texts; they cannot include explanations of the phenomena, which are contrary to scientific knowledge. The Exposition content cannot contain fairytale or science fiction elements, or those that breach moral norms.

3.2.3 The choice of the Exposition message must be adapted to a wide audience, but not disregarding the foundations of knowledge and texts must be approachable, using comprehensible vocabulary. The whole content of the Exposition message must be presented legibly (orderly).

3.2.4 Any other texts (e.g. voice messages, guidelines at the multimedia site, quizzes) must be available to visitors in two languages at least: Polish and English.

3.3 The requirements regarding the Exposition components

All the Exposition components, which are the subject of this Contract, should be unique, created specially for the Centre for Modernity Mill of Knowledge.

3.3.1 The Education requirements

3.3.1.1 The Exposition components must be designed in such a way that their reception by persons with different kinds of disability is the fullest.

3.3.1.2 The Exposition components should be adapted to needs of persons of different ages and different intellectual, manual or physical abilities.

3.3.2 The technical and operational requirements

It is assumed that the Centre for Modernity Mill of Knowledge each day may be visited by approximately 350 persons. The above information should be taken into account when designing the Exhibition for technical and operational requirements.

3.3.2.1 The Exposition components must be durable and resistant to the actions of the visitors:

- must remain efficient, despite daily mass and multiple use
- must be resistant to the actions of the visitors, both conforming and non-conforming with the Exposition messages
- must be easy to keep clean, especially in the case of scribbling with a marker, ink, paint, etc.

3.3.2.2 The Exhibition contents must meet the EU standards concerning the lamps and lighting, also for the workplace. The lighting sources should not dazzle the visitors nor expose their eyes to any risk. For more full reception of the Exposition contents and due to partial lack of the natural lighting of the Exposition area, individual lighting of the Exposition components should be considered. The lighting shall emphasize the most important components of the Exposition, but may not interfere with the observations of the Pendulum motion, or the use of the multimedia site.

3.3.2.3 The Exposition components must be made in such a way that the presence in the exhibition area does not expose the audience to danger and that their use is safe even for persons without training or without the aid of the animator.

3.3.2.4 Please ensure passable halls and corridors between the Exposition components, which should be also available for persons with disabilities, using wheelchairs.

3.3.2.5 The materials used for the implementation of the Exposition components must have safety approvals and comply with European standards for this type of facilities, be resistant to wear, washable and easy to maintain. The materials and technical solutions applied to the implementation of the Exposition components and possible consumables should be ecological and energy efficient.

3.3.2.6 The Exposition components maintenance should be internally feasible for the Employer.

3.3.2.7 Any and all doors, cabinets or other items fitted as part of the Exposition, protecting the equipment installed inside, intended for the operation or servicing of the Exposition components, should be equipped with locks with keys. The contractor shall hand over the keys to the Employer, including spare ones.

3.3.2.8 The Exposition operation (all items at the same time) must meet the requirements of standards of noise levels in places of work and public use.

3.3.2.9 Each of the Exposition components should have scheduled production of spare parts, which can be used for repairs (referred to in Section 2.3.1.1), performed during the guarantee period by trained employees of the Employer.

3.3.2.10 Each of the relevant Exposition components should have scheduled securing of consumables for one year of the Centre for Modernity Mill of Knowledge activity.

PART II – THE SPECIFICATION OF COMPONENTS OF THE FOUCAULT PENDULUM EXPOSITION

1 General requirements for all Exposition components:

- The the Foucault Pendulum Exposition shall be the pride of the location – the Centre for Modernity Mill of Knowledge in Toruń. Therefore, each of its components should be made with special care and attention to detail of construction and finishing. Visible from almost every place of exhibition area, the Exposition components not only are to serve the observation of specific phenomenon, but also to be spectacular enough to attract the attention of Visitors from the very entering the building.
- The Exposition components must remain efficient despite daily mass and multiple use.
- The Exposition components must be resistant to the actions of the visitors, both conforming and non-conforming with descriptions on Exposition messages, or in the manual of the multimedia site.

2 The Exposition components descriptions:

1	The exhibit of Foucault Pendulum , along with mounting system, including necessary structural components, and motion induction system.
Educational purpose	Demonstration of changes in the vibration plane of the Foucault Pendulum resulting from the Coriolis force – one of the inertia forces active in a rotating frame of reference, which is the Earth.
Components	<ol style="list-style-type: none">1. Steel structure that allows suspension of the Pendulum in the glass turret on the roof of the building.2. Suspension system for the Pendulum, designed so as to minimise the friction in the suspension point after the activation of the Pendulum to vibration.3. The Pendulum motion sustainment system acting in such a way as to allow the smooth change in the vibration plane of the Pendulum at a pace consistent with the theoretically expected at the latitude of Toruń.4. The Foucault Pendulum consisting of a heart suspended on a wire.
Dimensions	The Pendulum length – minimum of 33 m, maximum length depends on the final dimensions of the shaft and the turret, where the Pendulum shall be fixed. The Employer requires that the length of the Pendulum is the greatest at the final dimensions of the shaft because the Pendulum is to be the longest continuously effective Foucault Pendulum in Poland. The shape and dimensions of the Pendulum heart – selected optimally in order to ensure the correct operation of the Pendulum. The mass of the Pendulum heart – selected optimally in order to ensure the correct operation of the Pendulum.

The operation procedure	The Foucault Pendulum, set in vibrating motion, sustained by a special system, proposed by the Contractor, shall change the vibration plane in time consistent with the theoretical expectations. These changes shall be qualitatively observable for the visitors, plus they will be able to perform quantitative measurements of the deviation angle of the vibration plane depending on time, all during one hour observation.
Technical requirements	<p>General requirements:</p> <p>The Foucault Pendulum, along with the suspension and motion sustainment systems, will be used to demonstrate the experience that proves the revolution of the Earth around its axis. Therefore, the impact of forces disturbing the Pendulum motion, resulting from inaccuracies in the construction, the imperfections of the suspension system and the motion sustainment, or possible heterogeneousness of materials used for construction of the Pendulum heart should be limited as much as possible.</p> <p>Particular attention should be paid to the following aspects of the components of the whole system:</p> <ol style="list-style-type: none"> 1. The structure on which the Pendulum shall be placed along with the suspension and motion sustainment systems should be designed and constructed so as to secure long-lasting, continuous motion of the Foucault Pendulum and exclude the possibility of its collapse during operation. 2. The Pendulum dimensions (Pendulum length, shape, dimensions and mass of the heart and other components) should be selected to allow as long uninterrupted motion of the Pendulum as possible, also in case of motion sustainment system enabling.

<p>Technical requirements cont.</p>	<ol style="list-style-type: none"> 3. The Pendulum heart should be cast of metal and finished with the greatest possible care (the heart should feature the most possible uniform mass distribution in the entire volume, so as to minimize the possible impact of additional forces disturbing the Pendulum motion, in addition to those arising from the Earth revolution around its axis, and causing changes in the vibration plane of the Pendulum, in line with the theoretical expectations for not excited Pendulum). 4. The suspension system should include engineering solutions aimed at minimization of friction in the Pendulum suspension point. 5. The materials used for production of individual components should be of the highest quality and provide aesthetic appearance of the entire exhibit. <p>There are numerous historical studies on the experiment author – Leon Foucault and his work and professional studies on various kinds of design solutions and the pendulum motion sustainment systems as wells as possible disruptions of the pendulum motion.</p> <p>These include the following items:</p> <ul style="list-style-type: none"> – Wiliam Tobin, <i>The life and science of Leon Foucault</i>, – R. Stuart Mackay, <i>Sustained Foucault Pendulums</i>, American Journal of Physics, 21, 180 (1953); – J. Priest, M. J. Pechan, <i>The driving mechanism for a Foucault pendulum (revisited)</i>, American Journal of Physics, 76, 188 (2008); – H. P. Knauss, P. R. Zilsel, <i>Magnetically Maintained Pendulum</i>, American Journal of Physics, 19, 318 (1951).
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2	Arrangement of space under the Pendulum and around the Pendulum
Purpose	To enable quantitative and qualitative observation of change in the vibration plane of the Pendulum and to provide information and to provoke visitors thoughts on the experiment presented.
Components	<ul style="list-style-type: none"> – Basin under the exhibit of Foucault Pendulum – Wall behind the exhibit of Foucault Pendulum
Dimensions	<p>Basin under the exhibit of Foucault Pendulum:</p> <ul style="list-style-type: none"> – Basin diameter: 8.0 m – Basin depth: 0.6 m – For information purposes, the type and height of the barrier to separate the visitors from the basin area (the barrier falls <u>outside</u> the scope of the Contract subject): a barrier made of laminated transparent glass, crowned with a railing, the barrier height 1.1 m. <p>Wall behind the exhibit of Foucault Pendulum:</p> <ul style="list-style-type: none"> – Wall height: 3.0 m – Wall width: 5.8 m
The operation procedure	The arrangement components shall not enable a direct interaction with the visitors. The interaction with the visitors shall happen indirectly, because the solutions applied shall enable observation of change in the vibration plane and relevant quantitative measurements.
Requirements	<p>The arrangement should:</p> <ol style="list-style-type: none"> 1. Enable visualization of changes in the vibration plane of the Pendulum and quantitative measurements of the deviation angle of the vibration plane depending on time during one hour observation.

<p>Requirements cont.</p>	<p>These objectives can be achieved, <u>for instance</u>, by placing in the basin under the Foucault Pendulum exhibit such arrangement components as wind rose made of granite, a drawing showing the surface area of the northern hemisphere, appropriately precise angular scale allowing performing quantitative measurements of changes in the vibration plane of the Pendulum, collapsible posts or floor retractable ones, under the influence of contact with moving Pendulum heart.</p> <p>2. Provide information and provoke visitors thoughts on the experiment presented, <u>for instance</u> through competent selection and attaching on the wall behind the Foucault Pendulum of drawings, graphics, fragments of press and source texts dating back to Leon Foucault days, or use of themes of mathematics, geometry, related to the pendulum motion and forming their artistic conversion.</p> <p>The Employer emphasizes that the final concept of implementation of both components of space arrangement shall depend on the Contractor. Thereby, the Employer accepts other arrangement solutions than those examples provided above. The arrangement design shall be implemented following the final acceptance by the Employer.</p>
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3	Educational site with multimedia presentations , related to the inertial forces in non-inertial frames of reference and their influence on natural phenomena and the Foucault Pendulum motion.
Educational purpose	Provide information on the course and purpose of the experiment with the Foucault Pendulum in various places on Earth and its historical background, inertial forces in non-inertial frames of reference, examples of impact of these forces on the natural phenomena observed on Earth, or other interesting information related to exhibit.
Components	<ul style="list-style-type: none"> – Interactive multimedia intelligent kiosk – Multimedia software installed on the intelligent kiosk server introducing the visitors with all kinds of presentations related to the experiment with the Foucault Pendulum, the phenomenon observed, inertial forces in non-inertial frames of reference, examples of impact of these forces on the natural phenomena observed on Earth, or other interesting information related to exhibit.
Dimensions	<ul style="list-style-type: none"> - Height of the intelligent kiosk should be 100-120 cm, width up to 60 cm, depth up to 60 cm - Diagonal of the high resolution touch panel should be 19-21”.
The operation procedure	The exhibit shall allow direct interaction with the visitors, who will be able to choose the presentations viewed on touch panel.

Technical requirements	<ol style="list-style-type: none"> 1. The assembly based on anchoring to the ground, made of a material that provides daily mass and multiple use. The intelligent kiosk working on the base of electrical system featuring voltage of 230 V and structural network through RJ45 connector. 2. Standard configuration of the central unit (server located in intelligent kiosk enclosure) based on the leading technology processor, equipped with RAM DDR2 1 GB 400 MHz, hard disk drive with a capacity of at least 100GB 7200rpm, DVD-ROM, USB 2.0 slot, graphics and sound cards, network adapter 10/100/1000 Mb/s, service keyboard and mouse hidden inside the enclosure, ventilation system, active stereo speakers, the operating system MS Windows 7 or equivalent. A monitor resistant to daily, mass and multiple use, with a touch panel 19-21" featuring high resolution of approximately 1280 × 1024 pixels, brightness of ca. 300 cd/m², contrast of ca. 600:1. Additionally, the Contractor should provide the following: external keyboard and trackball intended for daily, mass and multiple use, camera, microphone, magnetic and chip card reader. 3. Multimedia software working on the operating system installed on the intelligent kiosk server, made in a technology using all advantages offered by formats like Flash, Java or any other multimedia format, designed for each age group of visitors thanks to the interface intuitiveness, and featuring upgradeability of installed applications or individual software modules with additional functionalities according to the needs of the Employer.
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