TECHNICAL DESCRIPTION OF THE INSTALLATION

1. Description of the boiler room

The aim of the study is to design a gas boiler room with a total output of 650 kW. The boiler room is subject to design requirements for large boiler rooms i.e. above 60 kW. Its task is to supply heat to three heating circuits with the following heating capacities: 260, 260 and 130 kW. The boiler room is to be installed in a room especially designed for this purpose on the ground floor of a 3-storey building. The room dimensions are as follows 10x5.3x2.8 m. There are also two 2x2m porches in the room at the internal and external emergency exits. The internal walls and doors will be made of a material with a fire resistance of 1 hour (REI 60). At both exits, the boiler room doors will open outwards when pushed (handleless). The floor of the boiler room will be covered with ceramic tiles, while the walls will be plastered. The boiler room will be equipped with natural ventilation. The required amount of fresh air will be delivered through 3 25x40 cm supply openings), located 20 cm above floor level. The 25x25 cm exhaust opening will be located on the opposite wall close to the ceiling. Lighting will be provided by two 120x150 cm windows and electric lighting. The boiler room will be supplied with treated, pure tap water. This will prevent the deposition of boiler scale in pipelines, fittings and directly in boilers.

2. Heat source

Three gas boilers from Viessmann, type Vitoplex 20, type SX2 with Unit Vitoflame 100 gas burner - two with 150 kW rated heating output and one with 350 kW rated heating output, were used to obtain the required output. The boiler provides high durability and safety due to the corrosion-resistant heating surface. The total dimensions of 150 kW boilers are: length 1385 mm, width 650 mm and height 1115 mm and of the 350kW boiler: length 1800 mm, width 730 mm and height 1225 mm. 150 kW boilers weigh 455 kg and the 350 kW boiler - 760 kg. Due to their large size, concrete foundations of 5 cm should be made under the boilers. The boilers are equipped with supply and return connectors with a diameter of 65 mm for 150 kW boilers and 80 mm for the 350 kW boiler and Syr safety valves, type 1915. On the back of the boilers there is a connection to the exhaust system with a diameter of 200 mm for the 150 kW boilers and 250 mm boilers for the 350 kW boiler and a vent. The distance between the boilers is 0.7 m. Behind the boilers, there are two drainage grates for draining water in the event of a leak or failure.

An overpressure flue system will be installed. The boiler room's exhaust system consists of a flue and chimney made of stainless steel pipes placed in a rectangular shaft. The installation is designed to discharge flue gases from a closed combustion chamber above the roof (60 m above the roof ridge). The flue gas temperature according to the manufacturer's catalogue is 195^{o}C. The amount of exhaust gas depends on the boiler output and is 250 kg/h for 150 kW boilers and 583 kg/h for the 350 kW boiler. Due to the small height of the building, a 10.1 m chimney has been designed. The connection of the flue with the chimney will be made at a 90-degree angle. The diameter of the chimney that allows the equilibrium equation to be obtained is 150 mm for 150 kW boilers and 250 mm for the 350 kW boiler. The diameter of the flue pipe is equal to the diameter of the chimney. The thermal insulation of the chimney must be made. At the bottom of the chimney an inspection and cleaning hole

has been provided, allowing periodical cleaning of the chimney and inspection of the condition of the pipes.

3. Supply of fuel and gas installation

The boiler room is powered by natural gas GZ-50 from a low-pressure network with calorific value of CV = 34 MJ/m^3 and density of ρ = 0.75 kg/m^3. On the external wall of the building there is a gas connection located in a locker, equipped with a gas meter and the main valve, enabling gas to be shut off from the building in case of failure. In order to be able to shut off each boiler and individual sections of the installation, shut-off valves are installed at the beginning of each section as well as at the burner. The diameters for the gas system have been calculated so that the gas flow pressure does not exceed the permissible value of 145.74 Pa and they amount to: from the external network to the valve and from the valve to the first flow - 100 mm, from the first to the second flow - 50 mm, approach to the boiler No.1 - 65 mm, approaches to boilers No. 2 and No.3 - 40 mm. Gas connection to the MatriX 32mm burner. The gas consumption of the MatriX burner is 16.89 m3/h for 150 kW boilers and 39.42 m3/h for the 350 kW boiler. Due to the fact that natural gas GZ-50 is lighter than air, a gas detector is installed above the boilers under the ceiling, which in the event of a leak will sound the alarm. The signal is activated if the gas concentration exceeds 10% of the lower explosive limit. The detector-gas circuit will be fitted with a solenoid valve that cuts off the gas supply to the boiler room in the event of a failure.

4. Hydraulic system

The hydraulic system of the boiler room consists of supply and return pipes connected with distributors. Pipe diameters have been calculated on the basis of the nominal flow and the flow rate not exceeding 1 m/s, and amount to: 80 mm - between boiler No. 1 and the first tee, 65 mm - approaches from boilers No. 2 and No. 3 to tees, 100 mm - section between tees and distributors. Each boiler is equipped with shut-off valves to cut it from the system. The return pipeline will be fitted with a closed expansion vessel with membrane, designed to equalise pressure and capture the extra volume of water created in the boiler (thermal expansion phenomenon). The Reflex expansion vessel, type NG100 with a capacity of 100 dm3, diameter 480 mm and height 644 mm was selected. The initial pressure in the expansion vessel p = 1.18 bar. It is equipped with a pressure gauge. In addition to the safety valves on the boilers, an additional valve was installed next to the expansion vessel in the event of boiler valves failure.

The division of water flow into three takes place in distributors, which were designed as horizontal cylinders with a diameter of 250 mm, ensuring water flow velocity of below 0.2 m/s during the distribution. Each heating circuit is supplied with a separate pipeline whose diameters are: 80 mm - for circuits 1 and 2, 50 mm - for circuit 3. On the supply of each circuit, before the mixing valve, there are pump systems consisting of: pumps, shut-off valves before and after the pump, non-return valve before the pump, as well as pressure gauges and thermometers.

In order to ensure the supply of adequate thermal power to individual heating circuits, quality control was applied. It was implemented with the use of mixing valves connecting the supply and return pipelines. These valves are controlled by actuators and their operation is coupled with the operation of boilers with a boiler controller. Boiler feed water is mixed with return water, therefore the water flow in the circuits is constant, while

the water temperature changes. All pipes within the boiler room should be insulated with foamed polyurethane.

A list of boiler room equipment:

No.	Item	Number	Manufacturer
1	Unit Vitoflame 100 burner	3	Viessmann
2	Vitoplex 200 heating boiler, type SX2, rated heating output 150 kW	2	Viessmann
3	Vitoplex 200 heating boiler, type SX2, rated heating output 350 kW	1	Danfoss
4	Pressure gauge 0-0,6 MPa	13	CASP SYSTEM
5	Temperature sensor Pt 100 EP100	12	Elpromix
6	Safety valve for boilers, type 1915 (2*3/4", 1*1 ½")	3	SYR
7	Safety valve on the expansion vessel, type 1915	1	SYR
8	Regulating valve STROMAX-GM/GR Ø 2 ½"	2	Danfoss
9	Ball valve DN 50	3	KDM
10	Ball valve DN 65	4	KDM
11	Ball valve DN 80	8	KDM
12	Ball valve DN 100	2	KDM
13	Circulator pump WILO Stratos – Z 40/1-8 CAN	1	WILO
14	Circulator pump WILO Stratos – Z 50/1-8 CAN	1	WILO
15	Circulator pump WILO Stratos 30/1-12 CAN	1	WILO
16	Expansion vessel, type NG100, capacity 100 l	1	REFLEX
17	Three-way mixing valve, type MIX-AP DN 80	2	Term - System
18	Three-way mixing valve, type MIX-AP DN 50	1	Term - System
19	Non-return valve DN 80	2	Danfoss
20	Non-return valve DN 50	1	Danfoss
21	Quick coupler with a drain valve Ø 1"	1	Afriso
22	Drain valve DN 25	4	UNISAN
23	Seamless steel pipeline (water) DN 50	-	-
24	Seamless steel pipeline (water) DN 65	-	-
25	Seamless steel pipeline (water) DN 80	-	-
26	Seamless steel pipeline (water) DN 100	-	-

27	Steel welded pipeline (gas) DN 40	-	-
28	Steel welded pipeline (gas) DN 50	-	-
29	Steel welded pipeline (gas) DN 65	-	-
30	Steel welded pipeline (gas) DN 80	-	-
31	Stainless steel flue pipe DN 150	2	-
32	Stainless steel flue pipe DN 250	1	-
33	Drainage grate	4	-
34	Vitotronic controller	3	Viessmann
35	Filter-clarifier DN 100	1	Termen
36	Rectangular ventilation duct made of galvanised steel	3	-
37	Ball valve DN 80	2	IDMAR
38	Ball valve DN 65	2	IDMAR
39	Ball valve DN 50	1	IDMAR
40	Ball valve DN 40	4	IDMAR
41	Aeration/Ventilation valve	1	Hawle
42	Distributor DN 250	2	-

ANNEXES
FIG.1 Detailed plan of the boiler room
FIG.2 Technological diagram of the boiler room