

ЭНЕРГОЭФФЕКТИВНЫЕ РЕШЕНИЯ CARRIER

В сегодняшней, зачастую непредсказуемой, ситуации, сложившейся на мировом энергетическом рынке, владельцы зданий находятся в постоянном поиске новых путей сокращения эксплуатационных расходов и способов максимально полно использовать уже имеющиеся ресурсы для того, чтобы обеспечить арендаторов надежными, экономичными, эффективными и экологически безопасными источниками энергии.

Одним из способов решения описанных выше задач является использование систем когенерации, тригенерации и применение гибридных схем.

Когенерация (Co-Generation – Combined Heat & Power) – это процесс совместной выработки двух разных форм полезной энергии из одного источника. Данная технология позволяет снизить стоимость производства энергии за счет повышения эффективности использования топлива и утилизации сбрасываемого тепла. При этом снижается потребность в покупаемой энергии, что способствует уменьшению эксплуатационных расходов зданий.

Графические данные

Процесс выработки может включать в себя любое сочетание двух различных видов полезной энергии (например, производство электричества и тепла, механической и тепловой энергии, электричества и холода).

Отметим преимущества использования когенерационных систем:

- Когенерационные установки являются экономически эффективным решением (долл./кВт). Они способны достичь высокого уровня энергоэффективности в процессе комбинированного производства тепла и электроэнергии, часто их КПД превышает 80%. Это значительно выше по сравнению с аналогичными показателями у коммерческих и промышленных газовых бойлеров.

- Системы когенерации – экологически эффективное оборудование. Их применение является одним из способов борьбы с парниковым эффектом (сокращаются выбросы парниковых газов).

- Отказоустойчивые газотурбинные установки (ГТУ) обеспечивают владельцев объектов надежными источниками электроэнергии и, в зависимости от потребностей, паром различного давления для производственных нужд или горячей водой со стандартными температурами (ГВС).

- Мощности установок могут быть адаптированы под конкретные нужды заказчика.

Примером гибридной схемы холодоснабжения* может служить офисное здание 65 Broadway (площадь – 350 тыс. кв. м) в финансовом центре Нью-Йорка.

Здесь Carrier применила систему когенерации на базе микротурбин и двух абсорбционных чиллеров серии 16JB плюс высокоэффективный чиллер 19XRV на базе центробежного компрессора, оснащенного частотно-регулируемым электроприводом.

В данном случае энергетическая система установлена параллельно с редукционным клапаном в уже действующем пароводяном контуре здания.



В зависимости от рабочих условий во вновь создаваемых системах микротурбины могут полностью заменять паровые редукторы, утилизируя тем самым избыточное давление пара. Устройство состоит из турбины, патентованной конструкции, установленной на планетарном понижающем редукторе, к которому, в свою очередь, подсоединен асинхронный генератор. Микротурбина, представляющая собой вертикальный блок, оснащена системой управления, которая согласовывает работу редукционного клапана, турбины и асинхронного генератора для обеспечения качественного электроснабжения здания, в том числе и при пиковых нагрузках.

Фирма, управляющая офисным зданием 65 Broadway, приобретает пар у энергетической компании Con Edison по двум тарифам Normal Day и New York Independent System Operator Day (NYISO). Это связано как с желанием создать максимально комфортные условия для арендаторов при минимальных издержках на энергию, так и с рентабельностью использования обоих тарифных планов.

В течение «обычного рабочего дня» потребность здания в холоде обеспечивается двумя абсорбционных чиллера низкого давления Carrier (холодопроизводительность 2100 кВт). Микротурбина отбирает пар с давлением 150 фунтов на 1 кв. дюйм (68 кг на 1 кв. см) из сети энергетической компании Con Edison, вырабатывает 275 кВт электричества и понижает давление пара до значения 10 фунтов на 1 кв. дюйм (4,5 кг на 1 кв. см), необходимого для работы абсорбционных чиллеров. Генерируемых микротурбиной электрических мощностей хватает для работы

центробежного чиллера 19XRV (холодопроизводительность 880 кВт) в период пиковых тепловых нагрузок.

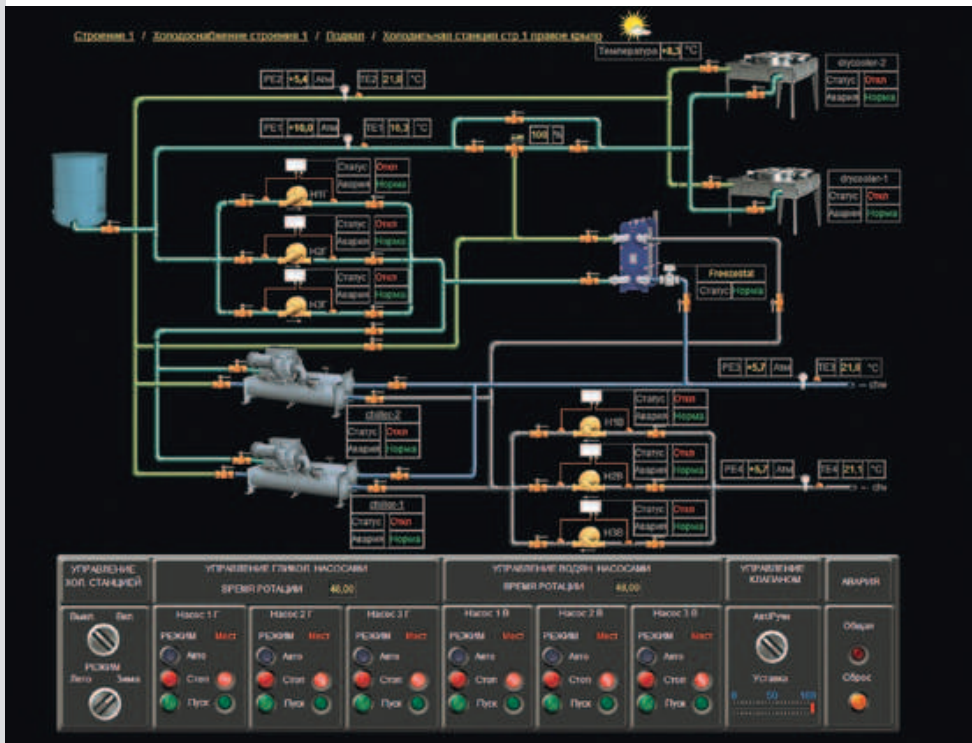
В рамках работы по программе NYISO Day два абсорбционных чиллера обеспечивают потребность в холоде системы кондиционирования объекта, в то время как электричество, вырабатываемое установкой, возвращается в городскую электросеть, что, по расчетам, дает управляющей компании экономии по коммунальным услугам порядка 75 тыс. долл. США. Кроме того, система сберегла зданию 400 тыс. долл. США, благодаря муниципальным скидкам в связи с участием в программе Администрации штата Нью-Йорк по вопросам энергетических исследований и развития (New York State Energy Research and Development Authority).

«Микротурбина, на самом деле, оказалась основной конкурентоспособности высокопроизводительной системы, которую нам удалось выстро-

Представление информации о комфорте в различных зонах



Чиллер 19XR

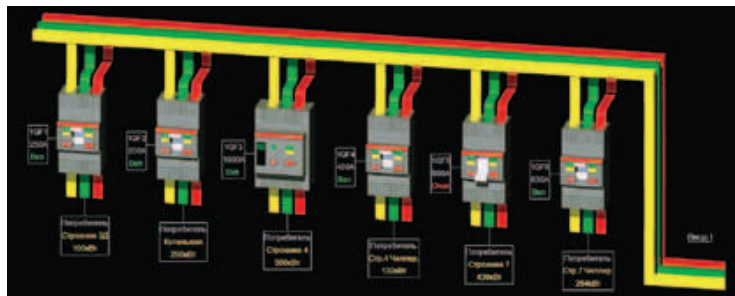


Холодильная станция

ить вокруг этой установки, – признался Эрнест Байрон, менеджер по продажам манхэттенского отдела Carrier Commercial Service. – Заказчик предпочел решение от Carrier, поскольку мы предложили систему, способную производить электричество и обеспечивать большую холодильную производительность при более продолжительном расчетном сроке службы и с более низкими эксплуатационными издержками».

Марк Фейт, главный инженер офисного центра 65 Broadway подтвердил, что долговечность оборудования рассматривалась как существенный фактор: «Система обеспечила высокопроизводительную работу, что характерно для двухступенчатых абсорбционных чиллеров, при отсутствии проблем, связанных с их сроком службы».

Оптимальным техническим решением при высокой стоимости или дефиците электроэнергии, по



Мониторинг автоматических выключателей

общему мнению, считается использование абсорбционных холодильных машин, которые имеют следующие особенности и преимущества:

- Холодильная машина экологически безвредна. Она использует в качестве холодильного агента водный раствор бромид лития вместо хладагентов. Незначительное количество движущихся деталей способствует низкочастотной работе машины без вибраций.

- Абсорбционные холодильные машины предлагают альтернативное решение, позволяющее экономить, в отличие от использования холодильных машин, работающих на электроэнергии. Благодаря использованию пара низкого давления, горячей воды или отходящего тепла абсорбционные холодильные машины Carrier не только уменьшают или полностью исключают расход электроэнергии, но и позволяют владельцу пользоваться программами скидок и поощрений, предлагаемыми многими коммунальными предприятиями.

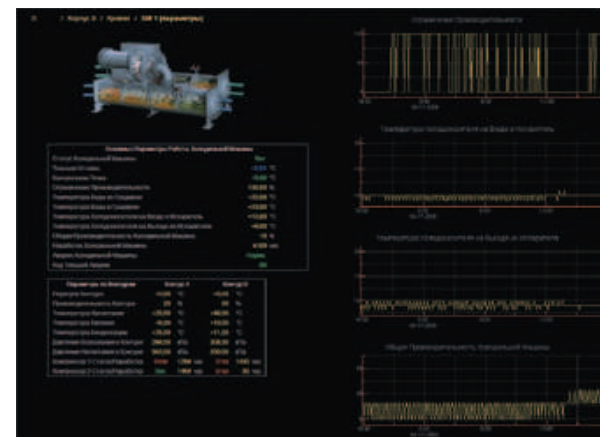
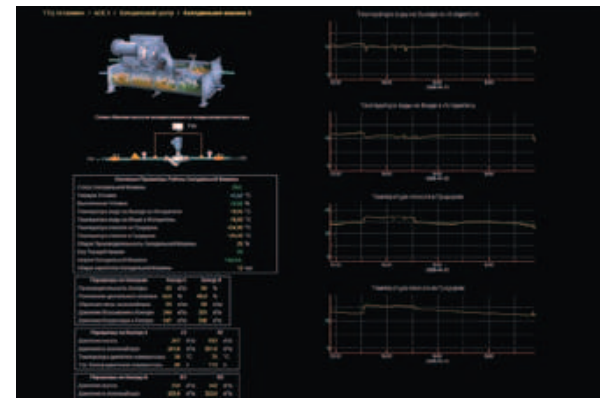
- Стандартная система регулирования концентрации раствора позволяет машине стабильно работать в режиме неполной нагрузки при температуре охлаждающей воды до $\pm 15^{\circ}\text{C}$, без байпасирования градирни. Это достигается за счет использования не имеющей аналогов системы управления расходом холодильного агента, запатентованной компанией Carrier (патент США № US6.260.364-B1), которая обеспечивает успешное управление при плавном изменении производительности машины в диапазоне от 100% до 10%.

- Легкий в использовании сенсорный экран, удачные алгоритмы обеспечивают точное регулирование производительности и оптимизируют работу холодильной машины. Функция автоматической самодиагностики способствует удобной и надежной эксплуатации. Есть возможность надежного взаимодействия с системой диспетчеризации и устойчивой связи с телефонной сетью.

- Система автоматической продувки компании Carrier продлевает срок службы машины, обеспечивает оптимальные энергоэффективность и рабочие характеристики. Она защищает машину от потенциальных опасностей, связанных с непрерывным выделением во время работы неконденсирующихся газов.

- Надежная и безотказная работа абсорбционных холодильных машин Carrier обеспечивается также системой автоматического ограничения концентрации раствора, которое осуществляется несколькими способами, предотвращающими как кристаллизацию раствора, так и чрезмерное его разбавление.

- Применение герметичных насосов существенно снижает затраты на техническое обслуживание. Проверенные длительными эксплуатационными испытаниями насосы холодильного агента представляют собой полностью автономные и герметичные устройства. Это исключает необходимость применения отдельной, достаточно сложной и не



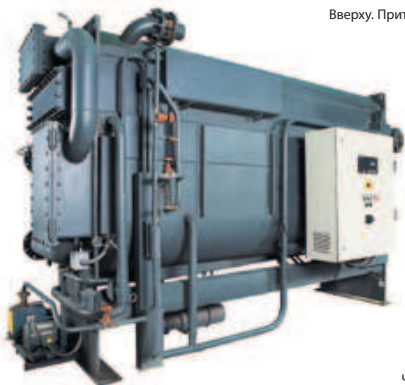
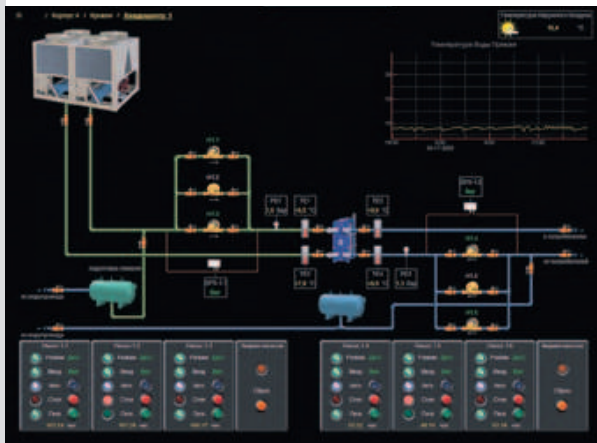
обеспечивающей полную герметичность системы, гарантируя в то же время практически полную герметичность и увеличенный срок службы машины.

Графические данные холодильной машины

- В холодильных машинах Carrier используется высокоэффективный ингибитор коррозии, обеспечивающий максимально возможную степень защиты от внутренней коррозии.

- Применение незабывающихся и защищенных от коррозии распылительных насадок способствует продолжительной и безотказной эксплуатации благодаря защищенности от коррозии и закупорки. Конструкция холодильных машин успешно выдерживает работу в самых жестких условиях как в системах комфортного охлаждения, так и в ходе технологических процессах.

Чиллеры Carrier Evergreen(tm), позволяют достигать высочайшей производительности в реальных рабочих условиях без вредного воздействия на окружающую среду. Официально подтверждено,



Вверху. Приточно-вытяжная установка.
Внизу. Холодоцентр

Чиллер 16JL

что чиллеры Carrier Evergreen имеют самый низкий коэффициент утечки хладагента среди аналогичного оборудования. Кроме того, конструкция чиллера позволяет хранить весь объем хладагента внутри установки и свести к минимуму риск его утечки во время сервисных работ.

Используемый экологически безопасный хладагент, высочайшая производительность и эффективная система управления делают чиллеры Carrier идеальными как для новых зданий, так и для реконструкции существующих объектов.

Еще одна система, позволяющая экономить на эксплуатационных расходах, – тригенерация. Это комбинированное производство электричества, тепла и холода. Холод вырабатывается абсорбционной холодильной машиной, потребляющей не электрическую, а тепловую энергию. Тригенерация выгодна, поскольку дает возможность эффективно использовать утилизированное тепло не только зимой для отопления, но и летом для кондиционирования помещений или для технологических нужд. Такой подход позволяет использовать генерирующую установку круглый год.

Перечислим характерные особенности этой системы:

- высокая энергоэффективность;
- ультранизкие выбросы в окружающую среду;
- внутренняя/наружная установка;
- масштабируемая конфигурация;
- минимальное количество движущихся элементов.

Она обладает также следующими преимуществами:

- минимальные счета за электричество;
- экологически безопасное решение;
- использование утилизированного тепла не только зимой для отопления, но и летом для кондиционирования помещений или для технологических нужд;
- максимальная экономия энергоресурсов;
- высочайшая надежность;
- долгий жизненный цикл оборудования.

Немалую роль в экономии эксплуатационных расходов играют и системы автоматизации и диспетчеризации. Компания Carrier предлагает в качестве такой системы использовать решение от Automated Logic Co. WebCTRL.

Как и другие подобные системы, WebCTRL состоит из двух уровней: автоматизации и управления. Обмен данными в системе осуществляется по протоколу BACnet, ставшему на сегодняшний день широко распространенным и стандартным для систем управления зданиями. WebCTRL предоставляет пользователю интуитивно понятный визуальный интерфейс, имеющий мощные инструменты для визуализации и управления инженерными системами. Для навигации по системе используется древовидная структура, группирующая объекты контроля по их физическому размещению в здании или комплексе зданий. WebCTRL отличает великолепная графика, разработанная профессиональ-

ми дизайнерами. Использование WebCTRL позволяет вам контролировать параметры здания из любой точки мира через стандартный веб-браузер с компьютера или мобильного устройства, исключая необходимость в специальном программном обеспечении.

Через веб-интерфейс вам доступны все функции управления зданием, включая:

- дистанционное управление оборудованием;
- настройку и изменение расписаний работы инженерных систем;
- корректировку технологических параметров систем;
- просмотр архивных записей параметров систем в графическом виде;
- просмотр и подтверждение тревог;
- получение отчетов об энергопотреблении, занятости помещений, действиях обслуживающего персонала и многих других;
- конструирование нестандартных отчетов, приспособленных к потребностям пользователя.

Тревожные сообщения также могут доставляться через SMS или электронную почту.

Основные преимущества использования WebCTRL:

- Программное обеспечение разработано с использованием только открытых стандартов и протоколов.

• В качестве платформы подходят самые распространенные решения, такие как MS Windows, Sun Solaris, Red Hat Linux, поддерживаются различные типы баз данных, например MS SQL Server, Oracle или My SQL, что позволяет минимизировать стоимость реализации и стоимость владения системой.

- Мощные средства разработки дают возможность значительно сократить трудозатраты и сроки реализации проекта и поддерживать или модернизировать систему дистанционно через сеть Интернет.

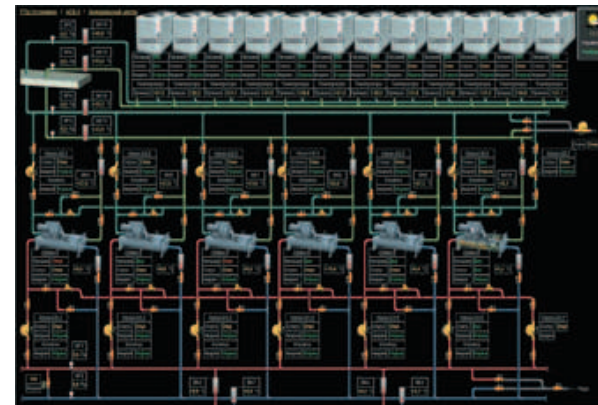
• Возможности интеграции оборудования третьих производителей позволяют объединить все инженерное оборудование в один слаженно работающий комплекс. Поддерживается множество промышленных протоколов: Modbus, Jbus, N2 Open, LonWorks, York, BACnet.

- Простая политика лицензирования и возможности масштабирования системы позволяют разворачивать ее поэтапно.

• Надежная и гибкая схема безопасности с использованием 128-битного шифрования для защиты соединения (SSL) исключает несанкционированный доступ к системе.

- Готовые программные решения дают возможность автоматически управлять энергопотреблением здания в целом в зависимости от потребности в тепле, холоде, тарифов энергоснабжающих организаций и других факторов.

Оборудование, использующее BACnet(r) протокол, может быть подключено по IP, ARCNET, MS/TP или PTP (точка-точка).



Кроме того, открытая система Automated Logic позволяет организовывать совместную работу с оборудованием, использующим BACnet, Modbus, N2, JBUS, LonWorks и многие другие протоколы.

Комплекс мероприятий, которые предлагает AHI Carrier, позволяет достичь максимальной экономии эксплуатационных затрат. Они включают в себя использование когенерационных и тригенерационных систем, современных чиллеров и автоматизацию и диспетчеризацию инженерных систем на основе передовых технологий управления. Это позволяет добиться максимально возможного экономического эффекта. ■

Комплексные решения AHI Carrier



AIRCONDITIONING & HEATING INTERNATIONAL
Lusinovskaya, 36 113093, MOSCOW, RUSSIA
Tel.: +7 (495) 937-42-41, Fax: +7 (495) 937-18-90
E-mail: ahi@ahi-carrier.ru

TABLE 23.
CORROSION PROTECTION FOR DIFFERENT GROUPS OF INSET COMPONENTS AND FITTINGS

# according to Table 22	Protective measures
Group I	1. 60 micrometer thick hot galvanizing. 2. 120 – 150 micrometer thick composite cold galvanizing (of ЦИНОЛ or ХВ-31 type) 3. Composite coating – cold galvanizing (ЦИНОЛ or ХВ-31) 60 – 70 micrometer thick and air resistant varnish-and-paint coating of IIa or IIIa groups (80 – 100 micrometer thick)
Group II	Concreting or monolithing together with protection of following types: 1. 50 micrometer thick hot galvanizing, 2. 60 – 70 micrometer thick cold galvanizing (of ЦИНОЛ type).
Group III	Concreting without any requirements to surface protection
Group IV	Monolithing together with protection of following types: 1. 60 micrometer thick hot galvanizing, 2. 80 – 100 micrometer thick cold galvanizing with ЦИНОЛ composition.
Group V	Protection is not required.

highly aggressive medium with any humidity level.

Operational conditions of inset components out-of-doors under influence of atmospheric precipitation are equated to operational conditions in moist and wet media.

Zinc-based protective compositions with high-molecular thermoplastic polymer ЦИНОЛ according to ТУ 2313-012-12288779-99 and ЦИНОТАН according to ТУ 2313-017-12288779-2003 is applied on surface of steel inset components and fittings.

Protection by composite or paint and varnish coatings is applied after erection welding of inset component and weld dressing. Restoration of destroyed coating over weld seam and adjacent area of inset component or fitting should be carried out using the same coatings, which applied for protection of facing part.

SECONDARY CORROSION

Secondary corrosion protection of constructions is prescribed by design in addition to primary protection, if the measures of primary protection do not ensure design operating life of constructions. Secondary protection presumes surface application of protective materials.

Protective options are to be selected taking into account technical and economic effectiveness. Duration of protection, expenditures for its realization and restoration, possibility or impossibility of protective coating restoration during operating life of constructions is also to be considered. If the surfaces of constructions are inaccessible for restoration of protection, the protective coatings should be as durable as the structure in whole.

Varnish-and-paint, thick-layered mastic coatings, backlining and facing materials (roll and tape) are used for renewable protection. Impregnating and tamping crystallizing penetrating materials are used for the nonrenewable protection.

The external lateral surfaces of underground constructions of buildings, and also enclosing constructions of basement accommodations (walls, floors), are to be protected from aggressive underground waters by mastic, backlining and facing materials. If cracks open in concrete monolith within the limits, indicated in Tables 15, 16, there should be used crackproof coatings. The application technology is to be provided by developers of materials. The surface of the driven and drilled piles must be protected by mechanically durable coatings or impregnations, which preserve protective properties while sinking. The watertightness grade of concrete for such piles must be not lower than W8. The application of bituminous coatings for the piles to be embedded into sandy, semi-gravel and other soils with gravel component is not recommended.

Drilled piles and constructions in aggressive soils and ground waters arranged as slurry wall should be made from concrete persistent in aggressive medium of this kind, or with secondary protection.

For liquid aggressive media concrete and ferroconcrete foundations under metal columns, and also the surface areas of other constructions must overhang floor level not less than 300 mm, or concreting of lower sections of columns one should not less than 300 mm higher floor level.

Isolation of foundations and floors must be continuous and one-piece, and its safekeeping is provided by temperature compensators. Movement joints are arranged, as a rule, in lift joints. Their airtightness is ensured by elastic compensators or padding with elastic chemically persistent materials. It is recommended to process surfaces of constructions of basement accommodations with high air humidity, and also with possible condensation of moisture with biocide solutions in order to avoid fungi lesion. It's also recommended to apply biocide

solutions over surfaces of rubbish chutes and garbage rooms.

Protecting lateral surfaces by roll isolation, the latter must be tucked under the bottom of foundation.

The bottom of concrete and ferroconcrete foundations should be isolated by materials persistent to action of aggressive medium. To protect bottom of foundation located at grade with aggressive ground water, taking into account the possible rise of water level, it is necessary to provide for:

- weakly and moderately aggressive acid media a kind of crushed stone cushion 100-150 mm thick from the dense igneous rocks with subsequent laying of acid-resistant asphalt;
- highly aggressive acid media replacement of aggressive soil by inert and additional gluing of two layers of roll isolation over acid-resistant asphalt with subsequent laying of another layer of acid-resistant asphalt;
- weakly and moderately aggressive sulfate media a crushed stone 100-150 mm thick cushion with further pouring with hot bitumen with the subsequent cushioning from concrete or cement-sand solution or layer of hot mastic asphalt;
- highly aggressive sulfate media besides ut supra cushioning from concrete or cement-sand solution over sulfate resistant Portland cement or with the addition of modifier on the basis of super-plasticizer and micro-silica.

Reliable waterproofing of floors of multi-storeyed parkings, which protects ferroconcrete constructions from aggressive action of anti-icing reagents brought with vehicles should also be provided.

If primary protection appears to be insufficient (Tables 4, 5, 6, 12) the surface of the driven and drilled piles must be protected from vibration by mechanically durable coatings or impregnation that preserve protective properties in the course of sinking. The cohesion value of coating with concrete must be not less than 0,4 mPa. Coatings for the piles to be embedded into sandy,

semi-gravel and other soils with gravel component is not recommended. Bearing capacity of piles with the surface protected by varnish-and-paint (mastic) coatings or impregnation should be defined by tests.

Underground constructions, which surface is rather inaccessible for arrangement of protection (drilled piles and constructions in aggressive soils arranged as slurry wall) should have primary protection including specific cements, additives, selection of concrete composition increasing its durability. Protection of sewerage conduits must be carried out with application of concretes with extremely low permeability (more than W8) and sulfate resistant cement or cements of the second group with simultaneous use of concrete modifier of МБ 01 according to ТУ 5743-073-46854090-98 or similar. If the degree of aggressive action of medium is moderate or strong, the secondary protection defined in some special design section should be additionally used.

Ferroconcrete constructions of balconies and stanzas, canopies over entrances, parapets and other constructions, which undergo the action of atmospheric precipitation, condensate and negative temperatures, should be made of concrete not lower than F200 frost resistance grade.

Highway constructions (road surfaces, collapsible pavement plates, curbstones and others), including garage driveways, which undergo the action of anti-icing reagents and minus temperatures, must be made of concrete of not less than F300 frost resistance grade, determined using the second method specified in ALL-UNION STATE STAN. 10060 (in brines).

To prevent the damage of facade surfaces of high-rise buildings made from concrete, which are exposed to aggressive gases, dust, slanting rains (including acid), the surface should be processed water-repelling solutions. Taking into account heterogeneity, low density and high water permeability of sand-clay concrete, it is recommended to reinforce soil-cement posts with composite rebar (ТУ 5769-248-35354501-2007) or with metal frames and rolled shapes protected by metallic or varnish-and-paint coatings. The specs of applying sand-clay concrete must be coordinated with specialized organizations. ■

ENERGY EFFICIENCY Energy Efficient Solutions by CARRIER

(p. 98)
TEXT BY MIKHAIL TEREKHOV,
PHOTOS BY CARRIER

Today, when the situation over global energy market is often unpredictable, the owners of buildings have

to seek permanently for the new ways to abridge operating costs and methods to use maximally the available resources in order to provide leaseholders with reliable, profit-proved, effective and environmentally-friendly energy sources.

A task solution dealing with above-mentioned issues is application of cogeneration, trigeneration systems or hybrid schemes. Co-Generation (Combined Heat & Power) is the process of joint production of two different types of useful energy by a single source. This technology makes it possible to decrease generating costs by more efficient use of fuel and utilization of expendable heat. It allows to manage by less energy to buy, which contributes to decreasing of operating costs.

Generation may include any combination of two different types of useful energy (for example: production of electricity and heat, mechanical and thermal energy, electricity and cold). Advantages of cogeneration systems:

- Cogeneration installations are cost-beneficial (\$/kilowatt). They are capable of providing high power efficiency in the course of combined generation of heat and electric power, frequently their efficiency factor exceeds 80%. This is substantially higher, if compared with similar indices of commercial and industrial gas boilers.
- Cogeneration systems are environmentally-friendly. Their application is one of the methods to resist greenhouse effect (reduced emission of greenhouse gases).
- Failsafe gas-turbine units (GTU) provide lessors with reliable electric power sources and, depending on needs, with steam of various pressure for industrial needs or hot water with standard temperatures (hot water supply).
- Unit's capacity may be customized for certain needs of a client.

The office building 65 Broadway (area - 350 000 m²) in New York downtown is an instance of hybrid circuit of refrigeration supply*.

Carrier deployed here the cogeneration system based on microturbine and two 16Jb absorption chillers plus highly efficient 19XRv chiller equipped with centrifugal compressor with frequency adjustable electric drive.

In the present case, the power system is installed in parallel with the reduction valve into already operating steam-water circuit of the building. Depending on operating conditions in the newly constructed systems the microturbines can completely substitute steam reducers, utilizing thus steam pressure excess. The unit is made up of a unique patented radial outflow turbine, mounted on an epicyclic speed reduction gear, which in turn is mounted on an induction generator. The vertical package is equipped with controls that synchronize the operation of the power reducing valve, turbine, and induction

generator to provide for a smooth transition of power to the grid.

65 Broadway, an office building in New York City, buys steam from Con Edison under two modes, "Normal Day" and "New York Independent System Operator Day (NYISO)." The facilities management team sought a cooling system that would maintain comfortable conditions for building tenants in the most cost effective, energy efficient manner while adapting to both Con Edison operating modes. During "Normal Day" operation at 65 Broadway, two Carrier low pressure absorption chillers provide 600 tons of cooling. The power system takes 150 psig steam from the Con Edison line, generates 275 kilowatts of electricity and reduces steam pressure to 10 psig to feed the absorbers. The electricity generated can run the 250 ton 19XRv chiller as needed.

During "NYISO Day" operation, the two absorption chillers handle the building's cooling load, while the electricity generated by the unit is returned to the facility's electrical distribution system, which is estimated to save management \$75,000 per year in utility costs. The package also secured the facility over \$400,000 in utility rebates under a New York State Energy Research and Development Authority program.

"The micro-turbine really gave us a competitive platform around which we could build a high performance system," said Ernest Biron, Sales Manager, Carrier Commercial Service, Manhattan. "The customer chose the Carrier solution because we offered a system that can make electricity and provide more cooling tonnage with a longer life expectancy and lower maintenance costs."

Mark Faith, Chief Engineer, 65 Broadway, confirmed that the equipment's expected longevity was an important factor. "The Carrier package gave us the efficiency of a double-stage absorber without the problem of the double-stage's short lifespan."

The optimal technical solution in the presence of high cost or scarcity of electric power according to all accounts is employing of absorption refrigerators. Features and advantages

- Refrigerator is environmentally-friendly. It uses as a coolant the aqueous solution of lithium bromide instead of Freon-containing products. Insignificant quantity of movable parts contributes to low-noise operation without vibration.

Absorption refrigerators is an alternative option, which makes it possible to economize, in contrast to electric-driven refrigerators. Because of utilization of low pressure steam, hot water or waste heat Carrier absorption refrigerators not only decrease or completely exclude power consumption, but also allow the owner to turn to advantage of discount and incentive programs offered by many municipal establishments.

Standard control system of solution concentration facilitate stable operation in partial load mode

at temperature of cooling water reduced to 15°C, without bypassing cooling tower pan. It is achieved by unique coolant consumption control system, patented by Carrier (US Pat. № US6.260.364-81), which ensures reliable control with smooth variation of productivity in the range from 100% to 10%.

Easy to operate touch-screen, perfect algorithms ensure precise productivity adjustment and optimize functioning of refrigerator. The function of automatic introspection contributes to convenient and reliable operation. There is an option of reliable interaction with the dispatcher system and steadfast telephone network connection.

Carrier system of automatic blowdown makes the machine more durable, ensures optimum energy-effectiveness and performance characteristics. It protects the machine from hazards connected with continuous emission of noncondensable gases in the course of operation, contributing to long-term durability and energy-effective functioning.

Reliable and trouble-free operation of Carrier absorption refrigerators is ensured also by the system of automatic limitation of solution concentration, which is achieved by several methods preventing both solution crystallization and excessive dilution.

Application of airtight pumps significantly decreases maintenance costs. The coolant pumps proved by long-term fleet testing are completely autonomous and airtight devices. This eliminates the need of deploying separate, fairly complicated system, which does not ensure actual airtightness, guaranteeing at the same time reliable airtightness and long-term operating life.

Effective rust inhibitor utilized in Carrier equipment ensures the highest possible protection from internal corrosion.

Application of nonclogging and rust-proof injecting caps contributes to prolonged and reliable operation. The design of refrigerators successfully withstands the most severe operational conditions in terms of comfortable cooling and in the course of workflow.

Carrier Evergreen™ chillers make it possible to reach the highest productivity under actual operational conditions without detrimental environmental effects. It is officially confirmed that Carrier Evergreen chillers have the lowest coolant leakage factor, if compared with similar equipment. Furthermore, the design of this chiller allows to store all coolant volume inside the installation minimizing the risk of its leakage during maintenance.

Environmentally-friendly coolant, the highest productivity and effective monitoring system make Carrier chillers ideal both for new buildings and existing facilities under reconstruction.

One more system, which makes it possible to save operating costs

is trigeneration. This is combined production of electricity, heat and cold. Cold is manufactured by absorption refrigerator, which consumes not electrical, but thermal energy. Trigeneration is quite profitable, since it allows to use effectively the heat not only in winter for heating, but also in summer for conditioning of accommodations or for technological needs. This approach makes it possible to use the generating utility the year round.

Characteristic features

- High energy-efficiency
- Ultra-low emissions into environment
- Internal/external installation
- Scaled configuration
- Minimum movable parts
- Advantages
- Minimum electricity bills
- Environmentally-friendly solution
- Effective utilization of heat not only in winter for heating, but also in summer for conditioning of accommodations or for technological needs.

- Maximum energy saving
- Highest reliability
- Long vital cycle of equipment
- Automation and dispatcher system

WebCTRL plays significant role in saving of operating costs. It consists of two levels: management and automation. At each level there is a possibility of selection of appropriate performance protocol: management - bacnet/ip or bacnet/ethernet, automation - bacnet/arnet or bacnet/mstmp.

Application of Automated Logic is the system of building automation, which offers insightful user interface and powerful controls.

Its navigation tree, smart colouring for displaying temperature in premises and its fluctuations, plus excellent graphics make WebCTRL very informative and usable. It may be illustrated by example of retail and entertainment complex "Yevropeisky" (European).

The WebCTRL makes it possible to control the parameters of building from any point throughout the globe by means of standard web browser, eliminating the need for special workstation software.

Web browser makes accessible all managerial functions of a building, including:

- customization and overparching of schedules;
- correction of default settings and other controlled parameters;
- visualized scanning of archived records of parameters of featuring systems;
- scanning and confirmation of alert signals;

- compiling of reports on energy consumption, occupation of premises, billing for leaseholders etc.
- (using the WebCTRL Report Generator you can easily create your own reports.)

Developed on proved and open source web technologies, the WebCTRL server is compatible with many basic platforms and databases, including Windows, Sun Solaris, Linux, MS SQL Server, My SQL, Oracle. The basic characteristics and

advantages of WebCTRL are:

- insightful dynamic graphics for overall monitoring of a building
- consistent and open source based package
- appliance of http web protocol for connection via the Internet or local network without additional software
- compatibility with various platforms, including Windows, Linux and Sun Solaris
- improved processing of alert signals, sending of messages via SMS or e-mail
- complex security system with multilevel access and 128-bit secure sockets layer encryption
- monitoring and control of power and HVAC equipment by off-site producers via the browser

Open system architecture of WebCTRL • supporting majority of commercial standards makes integration with the systems of third hand producers simple and easy. The WebCTRL is capable of supporting many protocols in terms of TCP/IP network, allowing to connect directly wide range of devices within the WebCTRL network.

The equipment, which utilizes the BACnet * protocol, may be connected by means of IP, ARCNET, MS/TP or PTP (point-to-point) procedures. In addition to this, the open system called Automated Logic makes it possible to organize joint operation of the equipment, which uses BACnet, Modbus, N2, JBUS, LonWorks and numerous other protocols. Combination of complex measures offered by AHI Carrier ensure maximum savings of operational costs. The package encompasses cogeneration and trigeneration systems, cutting edge chillers, and also automation and flow control of engineering systems on the basis of advanced monitoring technologies. All this allows to reach maximum affordability.

(*Refrigeration system based on different types of chillers - absorption and steam compression) ■

TECHNOLOGY Mass Emergency Evacuation Rescue System

(p. 104)
TEXT BY MIKHAIL FARBER, CAND.
OF TECH. SC.

Erection and operation of high-rise buildings become today the basic directions of urban practices. Shortage of vacant constructible sites in city centres urges to make buildings taller. Hundreds of offices and establishments are moving from old buildings into new contemporary skyscrapers, which are being attended or visited by thousands of people.

The more people work or live in high-rises, the higher risk of technogenic hazards in such buildings. Emergencies and fires in skyscrapers may lead to the most lamentable consequences, taking into account the density issues. Moreover, it is impossible to discount such a terrible social phenomenon, as terrorist threat.

Engineer thought searches to meet these challenges, trying to create reliable high-rise habitat. The systems of power supply are becoming redundant, automatic fire extinguishing systems are being implemented, egress and emergency evacuation procedures are being developed.

This sort of means includes the unique mass evacuation emergency rescue system intended for high-rise buildings, which is being described in this article. It is developed in Israel and aimed at rescuing people in case of any emergency: fires, earthquakes or terrorist attacks.

This system is originally designed for collective, mass evacuation. To be independent on building's condition, it is positioned and operates externally, has autonomous power sources and controlled by dashboards. Emergency rescue system ensures rapid simultaneous evacuation of up to 135 people of any age and even disabled persons. Along with this the system delivers rescuers, firemen or snatch squads on-spot.

Emergency rescue system effective operation presumes brand new design approach. Creating of rescue procedure requires the original engineering solution - application of Matryoshka (Russian Dolls) principle to arrange multiple escape capsules stored compactly folded to be open up promptly in case of emergency. This solution is protected by several patents acknowledged in the USA and EU.

Mounting and installation of the system require customization for each case, which includes arrangement of immediately accessible escape paths. Rescuers should be able to open these exits from the outside and shut them on leaving. It is necessary to provide ramps for wheelchairs leading from the building right into the escape capsules. Some additional concealed cable guides may be arranged outside to make the installation more reliable.

In fact, the emergency rescue system is to be mounted on the roof of both existing buildings and ones being underway. The major elements of its design are the base, welded to the ferroconcrete body of building, the mechanical enabling and motion system, two autonomous generators (power source), two dashboards at different points at ground level and the set of convertible rescue capsules. To resist critical conditions of fire the capsules and hardware are made from refractory materials.

It's important to consider that the first dashboard may be located in the building itself, inside the control room, and the second (standby) one -

TABLE 1

Parameter	Standard version	Compact version
Maximum building's height	200-300 m	300 m
Number of capsules	Up to 5	2
Folded capsule dimensions	300x150x250 cm	250x150x200 cm
Width of entrance/exit path	75 cm 120 cm	80 cm 120 cm
Maximum number of evacuees	135 persons	35 persons
Weight	14 000 kg	8000 kg
Dimensions of folded system	Width - 467 cm Height - 493 cm Length - 514 cm	Width - 340 cm Height - 450 cm Length - 400 cm
Agility	80-70 m/min	130-120 m/min
Cable's safety margin, not less than	x10	x10

in some adjacent building or in some special accommodation.

Let us examine the system's operation in more detail. In case of emergency the installation is enabled upon command from the dashboard and gets down. Several Matryoshka-like capsules move downward to be unfolded and let rescuers and firemen inside. Then all the stuff is elevated up to escape exits of several floors at the same time. On opening of exit from outside (it may be automated) the team enters inside - into the holding cell for evacuees.

People are being evacuated from several floors simultaneously. After capsules are loaded the system delivers the passengers down to the ground. Each upper capsule inserts the lower after people are out. System unfolds in the reverse sequence letting in the new group of firemen. After this, the capsules are ready to rise again to evacuate the following group.

The most prolonged evacuation cycle from upper levels of the highest buildings lasts 8-10 minutes.

To adapt better to certain building, the two basic configurations of emergency

rescue system were developed. The most important technical parameters are given in Table 1. The basic distinctive features of the versions are size, number and agility of capsules.

The data from Table 1 proves that the standard version features the system able to carry 27 persons, in comparison with 17 in the compact version. Whereas the compact version is twice as more agile. These two parameters greatly influence the duration of evacuation cycle and number of evacuees.

Calculation of both indices during given period depending on height of building and number of floors, system's version and quantity of capsules are given in Table 2. The analysis shows that standard configuration ensures approximately 50% more evacuees for the same period of operation. Meanwhile, evacuation cycle of the compact system is half as shorter than for the standard one. Density analysis of some certain building makes it possible to select the system appropriate the most taking into account the number of visitors and extent of escape paths. There may be

TABLE 2

Number of floors	40	50	50	60	60
Height, m	180	225	225	270	270
Number of capsules	3	4	5	5	2
Agility m/sec	1,2	1,1	1,0	1,0	2,0
Duration of evacuation from upper floors, min	6,4	8,6	9,6	11,1	5,6
Duration of total evacuation, min	50	61	57	79	98
Number of evacuees	972	1215	1188	1485	986

installed several compact systems or standard and compact system at the selected points. This allows feasible selection of the system configuration, since the compact configuration is approximately by 40%, and sometimes twice as cheaper than the standard one. Anyway, the cost of rescue system is less than 1% of total building cost and would be not a circumstance to victims compensation, if there were no any protection.

Emergency evacuation rescue system for high-rise buildings is developed in accordance with the American standard ASTM E2513-07, Specification for External Emergency Evacuation Platforms for High-rise Multistory Buildings. It satisfies the requirements of affirmed a year ago Federal Law on Technical Regulations of Fire Safety Requirements. As the system is the means of collective rescuing from the height in fire conditions (Articles 47 and 80), it is designed with regard to such crucial requirements as width of emergency exits (Article 89, Paragraph 6.5) and minimal sizes of folded system. Thus, it occupies less area than it is assigned on the roof, according to the law, for transport-rescue cockpit of helicopter (Article 90, Paragraph 17).

For the first time in the world the operating system of mass evacuation is deployed in Tel Aviv (Israel) on one of the highest skyscrapers of the region and it still functions. It is usually used as a hoist for out-of-gauge cargo, if it is necessary to elevate some new equipment for repair works. There are about 10 more systems underway in different stages of production and installation in different cities worldwide.

In future this and similar emergency rescue systems are set to become the integral part of engineering equipment to be considered by design and maintenance schemes for high-rise buildings. Only this kind of equipment ensures escape of so many people in far shorter time, if compared with emergency rescue helicopter or using individual means of evacuation. This system is capable of saving people of any age, able or disable, it is compact and economically feasible.

To discuss design and delivery points just turn to: Colored Glass Printing & Building Innovative Solutions
phone: +972- (0) - 54-3113267
fax: +972- (0) - 77-5161415
e-mail: printonglass@013.net
www.coloredglassprinting.vivity.com ■

MONITORING
Monitoring
Systems
(p. 108)
TEXT BY ANDREY
SHAKHRAMANYAN, CAND. OF
TECH. SCIENCES, GM OF SODIS,
NIIMOSSTROY HEAD OF DIVISION
OF COMPLEX DEVELOPMENT AND
IMPLEMENTATION OF TECHNOLOGIES
PROVIDING SAFETY OF HIGH-
RISE AND UNIQUE STRUCTURES,

NIIMOSSTROY CHIEF OF EXPERT DIVISION FOR EXAMINATION OF BUILDINGS AND CONSTRUCTIONS INDUSTRIAL SAFETY

Technological basics of architectural of monitoring systems for high-altitude and unique structures

Unfortunately, recently there have been more and more accidents on construction sites. Yearly we have to face the need for carrying out the independent analysis of collapses, dilapidation of buildings and facilities. These structures are, as a rule, the places of gathering of large number of people, which emphasizes the significance of the problem and the importance of seeking for methods of its solution to avert irreversible consequences.

The urgency of this problem and the latest industrial tendencies in Russia and intensity of large-scale units erection determines the need for development of new structural safety elements. One of which is the automated structural deformation monitoring systems. The need for such systems is reflected in the existing normative and guideline basics and is considered in the course of development of new normative documents on building safety.

STRUCTURAL MONITORING SYSTEM DEVELOPMENT STAGES

The usual practice and regulations presume development of structural monitoring system at the design stage, harmonization at the building stage and application in the course of erection and operation of buildings and facilities to control structural adequacy (Fig. 1).

At the design stage the hazard model of probable dilapidation is to be outlined. Such model is developed on the basis of location (climatic and geological conditions), design features, purpose of a structure.

Based on the hazard model one should determine the list of parameters to be monitored, processing procedures and technical state evaluation criteria.

Using contemporary finite-element analysis tools (ANSYS, "Lyre", MicroFe etc.) a mathematical and computer model of a structure to determine estimated (permissible) values of parameters should be developed.

On the basis of parameter list a set of certain physical quantities (deformation, fluctuation, pressure and of others) and monitoring equipment should be composed.

At building stage the monitoring equipment - strain, pressure, temperature, acoustic emission, vibration sensors (accelerometers, velocimeters), tachometers - are to be installed and enabled. In the course of building the monitoring results obtained using this equipment is compared with previously simulated or estimated values. On building completion the adequacy of mathematical model is to be validated (if necessary, it should be adjusted), and also monitoring result processing

procedures and decision making criteria are to be fine-tuned.

STANDARD SOLUTIONS OF STRUCTURAL MONITORING SYSTEM ARRANGEMENT. COMPOSITION AND STRUCTURE

The structural monitoring system can be represented as set of following functional blocks (Fig. 2): 1) primary sensors and equipment;

2) data collection and recording system;

3) mathematical and software tools.

Primary sensors and equipment are intended for registering of different parameters, which characterize the stress-strained state of separate constructions or group of them. Sensors record such parameters as inclination, sediment, deformation, pressure, space coordinates, frequencies and fluctuations (acceleration, speed), temperature, humidity.

Data collection and recording system is intended for consolidation of primary data according to the results of measurements, digital transformation of signals from sensors and storing of obtained data.

Mathematical and software tools is the intellectual nucleus of monitoring system consisting of the following systems:

1) structure's mathematical model;

2) software set (special processor) for complex processing of monitoring results, estimation and forecast of structural technical state;

3) monitoring system management software pack, which creates reports on results of monitoring.

Mathematical model of a structure is created to determine design values of parameters for monitoring system (for example, calculated deformations in base plate, piles, load earring constructions, dynamic characteristics, such as frequency and oscillation amplitude, transfer functions etc.).

Fig. 3-5 represents some results of mathematical simulation for the monitoring systems of the building of legislative and executive city authorities in the Moscow City and the headquarters Siemens and AFK Sistema (Moscow, 39, Leningradsky Avenue), the high-rise building within the scheme called "New Ring of Moscow" (54, Altufevskoe Highway). Our experience proves that the mathematical model should be created independently from design model of a structure developed by designers. Firstly, these models have different purpose - they are developed to determine and select certain constructive solutions. Monitoring model is intended for initial determination of controlled parameters and further operation of monitoring system after the structure is completed and put into operation. Secondly, the independent model makes it possible to estimate its adequacy and correspondence of a structure to design solutions with more reliability. Monitoring system mathematical models are fine-tuned in the course of building and obtaining of real indices from sensors. As a result, on building completion

the mathematical model of the object of monitoring (after all refinements) corresponds to its real features and is used in operated structure to analyse the results of monitoring, estimation and forecast of defects progressing and it ensures the objectivity of monitoring results analysis.

Monitoring system software is intended for:

- management of monitoring system;
- collection and storage of the information, obtained from sensors and equipment;

- data processing and analysis to determine structural technical state;
- tuning and operating procedures of monitoring system's special; processor to automate determining of structural technical state;

- specifying of managerial decisions and recommendations regarding further most effective operation of a structure;

- integration of monitoring system with other internal dispatcher systems external systems of urban infrastructure.

The examples of specialized structural monitoring system software SODIS Building M operation (designed by SODIS, the RF Patent № 2009612830) are shown in Fig. 6 and 7.

Mathematical and software tools allow processing of field measurements along with comparative analysis with design values, obtained in the course of mathematical simulation. This gives the possibility not only to estimate the current structural state, but also to make reliable forecast. Thus, for instance, developed by SODIS in association with NIIMOSSTROY the software pack SODIS Building M and the set of mathematical models on the base of finite-element analysis tool ANSYS 11 makes it possible to determine the trends of controlled parameters (for example, uneven sagging) for the forecasted period and to evaluate using computer simulation the influence of forecasted values of controlled parameters for the future technical state of a structure.

Monitoring system does not just report of unfavorable factors to the maintenance service, but also is able to make assumptions, for example, that if in five years prospect no any measures are applied, the technical state of the building would be reckoned as invalid. Fig. 8 renders the graph, drawn by monitoring system showing forecast of the structural technical state.

REFERENCES
1. RF Patent for useful model № 66525 Monitoring System of Technical State of Buildings and Facilities

2. Eurasian Patent № 006970 Methodology and System for Determining of Stability of Buildings and Facilities

3. Certificate of the RF Committee on Patents and Trademarks № 2009612830 Automated Monitoring System of Technical State of Buildings and Facilities based on Geo-information Technologies (SODIS Building M2.5)". ■