



Structure Monitoring Technology

FutureCast ™
ACTIVE

The logo icon for FutureCast consists of a central Wi-Fi symbol surrounded by a circular arrangement of plus signs.

From Deck to Cloud:
Leak Detection Systems for
Inverted Roof Assemblies

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INTRODUCTION

We are delighted that you are considering SMT for your project. For over 15 years we have been trusted by architects, general contractors, roofers, and building owners to install state-of-the-art sensors and enable the best possible leak detection.

FutureCast is a Leak Detection System (LDS) for inverted/protected roof assemblies. It enables non-destructive monitoring of the roof assembly, saving time and reducing the scope of costly tear-up during a leak inspection, ultimately limiting inconvenience to tenants and disruption to business.

Used properly, a FutureCast can:

- Monitor the integrity of the waterproof membrane
- Alert owners to membrane deficiencies which can indicate a leak
- Guide maintenance managers in a leak investigation
- Verify the success (or failure) of leak repairs
- Inform decisions on deferred maintenance
- Extend the useful life of the roof
- Give tenants peace of mind

This document gives an overview of how FutureCast works, the steps required to install and operate the system, and the benefits to the structure and its owners.



Above: FutureCast sensors sit on top of the waterproof membrane, and are covered by insulation and overburden.

DESIGN + INSTALL CHECKLIST

The following check-list outlines the process for design and installation of a FutureCast Active Leak Detection System on an Inverted Roof Assembly.

1. Design Team/Roofing Contractor submits drawings of roof deck/landscape area to SMT.
2. SMT provides a Budget/Estimate for the Project.
3. Project goes ahead. SMT receives a Purchase Order/Deposit for Material procurement.
4. Roofing Contractor prepares roof deck for installation, coordinates with project site supervisor and SMT operations manager to schedule install.
5. SMT installs FutureCast sensors directly on top of the waterproofing membrane.
6. SMT connects direct burial cable from the sensors.
7. The Roofing Contractor covers the FutureCast sensors/membrane immediately.
8. SMT installs a junction box on the roof deck, some projects require multiple boxes.
9. SMT routes cables from the FutureCast sensors to the junction box.
10. Electrical Contactor routes power and data connections to junction box
11. SMT installs Monitoring Electronics in junction boxes
12. Building Owners and SMT agree Monitoring Contract
13. SMT provides additional services as agreed in contract, including:
 - Submit FutureCast Active Basic Report
 - Submit FutureCast Active Advanced Report
 - Perform System Maintenance / Updates
 - Provide system training for Maintenance Team
 - Provide additional Leak Detection Services

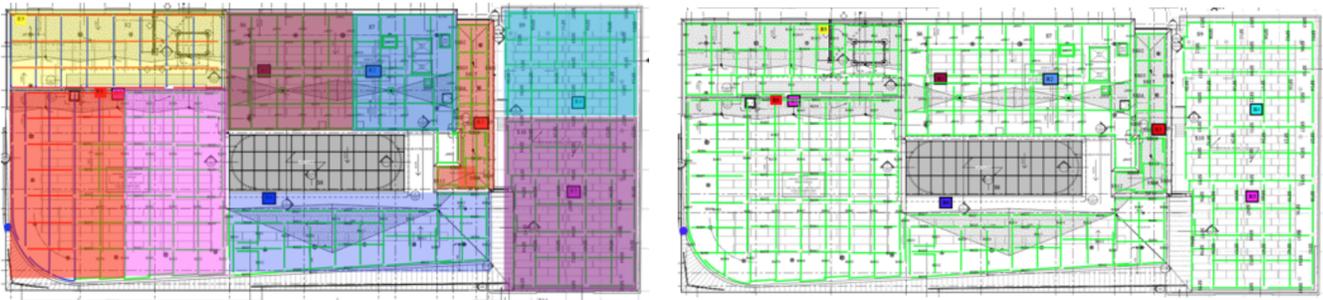
Read on for a more comprehensive overview of the FutureCast Active system, or contact SMT to discuss how we can assist on your project.

BUDGETING AND PLANNING

Defining the Scope of your System

Our team will advise and educate on Leak Detection in general, and help find the right scope and configuration of Leak Detection System for your project. For designers, SMT offers ready-made specifications for FutureCast systems; these can be found on our website and inserted directly into the project specification.

A budget estimate can be produced in short order if SMT is provided with clear drawings. SMT technical consultants will create CAD drawings to show where the system will be installed, splitting the roof deck into zones based on square footage and topography.



*Roof Deck divided into zones for FutureCast Active Install (Left)
FutureCast sensor grid gives wide coverage of roof deck (Right)*

Who to Call

Technical Consultant: for assistance with design, budget estimates, and quotes. They can provide updated quotes as project specifics change over time.

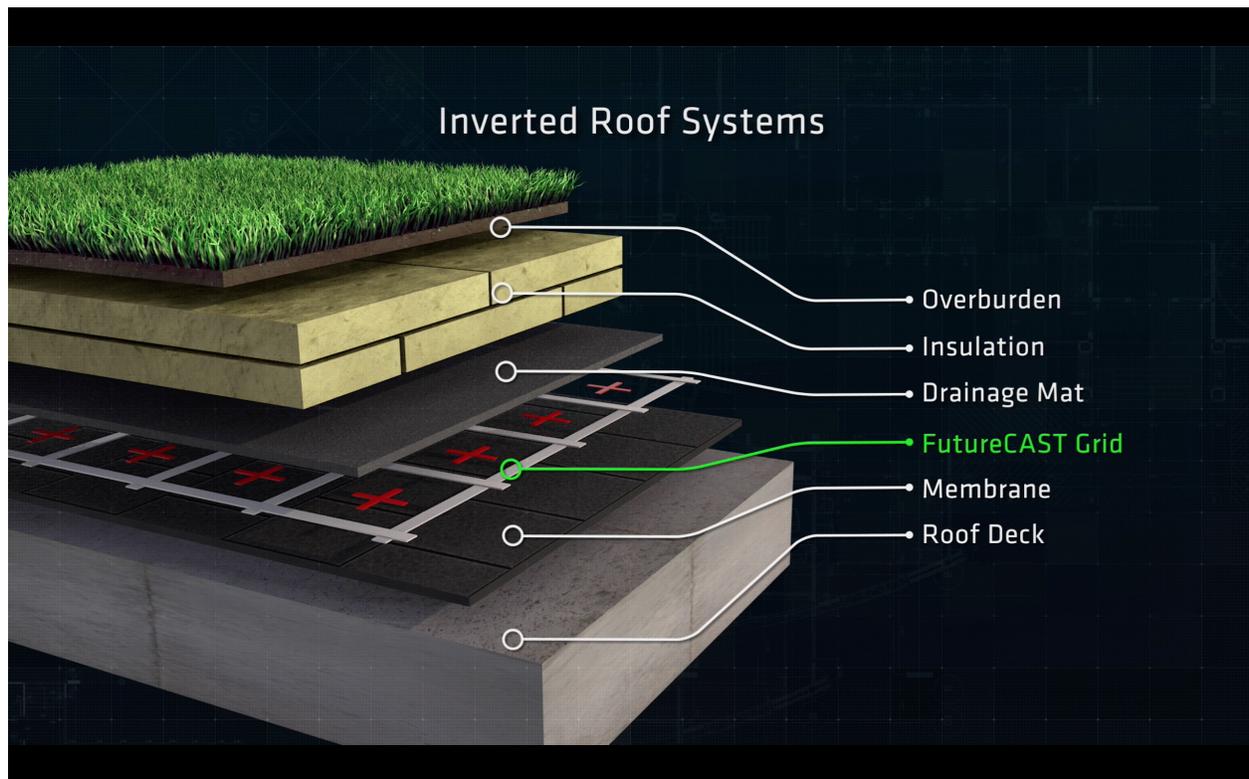
Operations Manager: for availability of technicians and scheduling installation of FutureCast Active Leak Detection System. They are also your point of contact for billing and reporting.

Project Manager: SMT's project manager will keep everyone informed on a daily basis of project progress and any needs that may arise.

HOW IT WORKS

The Technology:

FutureCast Active works using a method called electronic field vector mapping. This method creates a positively charged electric field on the top-side of the waterproof membrane, which should feature evenly distributed voltage on an intact membrane. Where the membrane has been penetrated or insufficiently applied, there will be potential for the positively charged electrons to pass through the membrane and into the grounded substrate (i.e. the structural element of the roof). These deficiencies are areas where water may be allowed to enter into the structure and cause rot, mold, and decay. FutureCast's Digistar sensors are sensitive to changes in differential voltage, and when activated will take measurements that can be used to produce a structural integrity "heat map" of the waterproof membrane.



Above: The FutureCast Grid is a network of sensors applied directly to the waterproof membrane, and subsequently covered by layers of insulation and overburden.

INSTALLATION

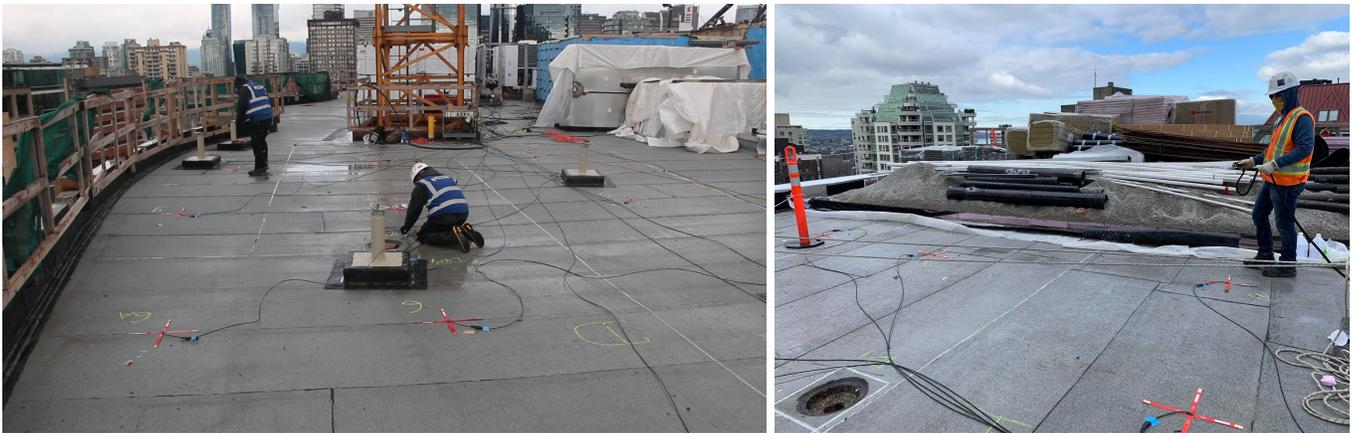
Preparing the Deck:

SMT works within the set construction schedule, communicating with roofers and site supervisors as is necessary to install the system efficiently. The deck must be clean and dry. Metal debris and any sources of moisture, no matter how small, should be actively looked for and removed.

Applying Sensors:

SMT applies strips of Electric Field Tape (EFT) directly on the waterproof membrane. EFT is low-profile mylar with twin strips of stainless steel conductor on one side, and adhesive backing on the other. This tape is applied in a grid-like fashion at 20ft intervals, with options for 6ft x 6ft, and 10ft x 10ft also available if required. A directional voltage differential sensor (Digistar) is applied in the middle of each grid section.

Any metallic/conductive features that will be permanently present on the deck (such as drains) are isolated from the grid by application of additional EFT, the perimeter of each zone is also isolated with EFT so that it does not interfere with future readings.



*Above Left: FutureCast Digistar Sensors and EFT are applied directly onto the membrane.
Above Right: The FutureCast sensors are attached to routed cable, and covered by roofing contractors.*

Wiring and Covering the Sensors:

Technicians connect a terminal block to each EFT strip and Digistar, followed by a length of direct

burial cable. The cable is bundled and routed in as efficient and unobtrusive manner as possible. The zone is then handed off to roofing contractors so that the system can be quickly covered by cover board, insulation, and the waterproof membrane. It is important to be cautious so there is no damage caused to any exposed sensors.

Junction Box Placement:

The sensor cable is then routed to a watertight junction box located in a convenient location at the roof deck level. The location of the junction box is decided during the planning phase, but there is flexibility if site conditions require alternative placement.

On a typical installation, each defined zone of the roof will have its own junction box (or as many boxes are required for the number of sensors). Different sized junction boxes are used depending on the scope of the zone. The junction box is best placed at the edge of the system, mounted to a prevailing wall detail or in grade with a free standing flashing stack.



junction boxes mounted to wall (left), free standing (middle), and interior (right)

DATA ACQUISITION

Digistars are passive sensors. In order to actively monitor the roof assembly, FutureCast requires each deck level junction box to have electronics, power, and connection to a Building Gateway. These steps require collaboration between SMT and electrical trades, and must be carefully considered during the planning phase. Read below for a detailed explanation of each requirement.

Electronics and Power: SMT will install a custom data acquisition board (DAQ) in each deck-level junction box, this can be done after the waterproof membrane has been installed. Each junction box requires a 12V DC connection to power the DAQ, Digistars, and EFT. The DAQ is programmed to take capacitance-based measurements from the Digistars at custom intervals, and continually check for system function.

Building Gateway: In order to upload data to the cloud for analysis, FutureCast Active requires a Building Gateway. In most typical installations, each junction box will have its own Tactical Intelligence Gateway (TiG). The TiG is a compact Linux based computer system which requires a static IP and either solar, battery, or hardline power. These gateways allow front end control of the system, as well as data monitoring and back end control from remote locations.



*SMT can mount junction boxes onto nearly any surface, and offer various options for clients that want a more discreet aesthetic. Inside the junction box, electronic components are arranged to minimize the required space.
Above Right: A centralized gateway with windows laptop running BiG software, allowing greater front-end control*

Additional Data Acquisition Considerations:

Centralized Building Gateway: In rare cases, a FutureCast Active system may be designed with a Central Gateway rather than each deck level junction box having its own gateway. The Central Building Gateway is housed in a junction box in a secure location, decided upon during the planning phase.

BiG: As an alternative to the TiG, BiG is a windows-based software system which enables the broadcast of data packages from the sensor network to the cloud for analysis, visualization, and alarm setting. BiG allows the FutureCast Active system to interface directly with Building Management Systems, and is most commonly used by researchers, or clients who prefer a greater deal of interaction with the system.

Wireless Data Transmission: Some clients do not wish to route data cables to deck level junction boxes or central gateways. In this scenario, a cell modem can be installed in each deck level junction box in order to transfer data to the cloud. The running costs of wireless systems are handled by the building owner.

BMS INTEGRATIONS

Some clients wish to have the FutureCast Active LDS integrated into their Building Management System (BMS). SMT utilizes the BACnet building automation and control networking protocol, a fully autonomous, always online, executive control interface. Developed by ASHRAE, BACnet is accessible both remotely and locally, and has become the protocol of choice for most building automation control networks.

The Building Gateway communicates to 3rd party BACnet systems using BACnet IP over a standard ethernet network.

For clients that want a more customized solution, SMT offers an API for interfacing to other online Building Management Systems and Building Information Model (BIM) related graphical tools. FutureCast sensor status can be visualized on BIM models to enhance the visibility of the leak location and the conditions that lead to the leak.

ANALYTICS, ALARMS, & REPORTS

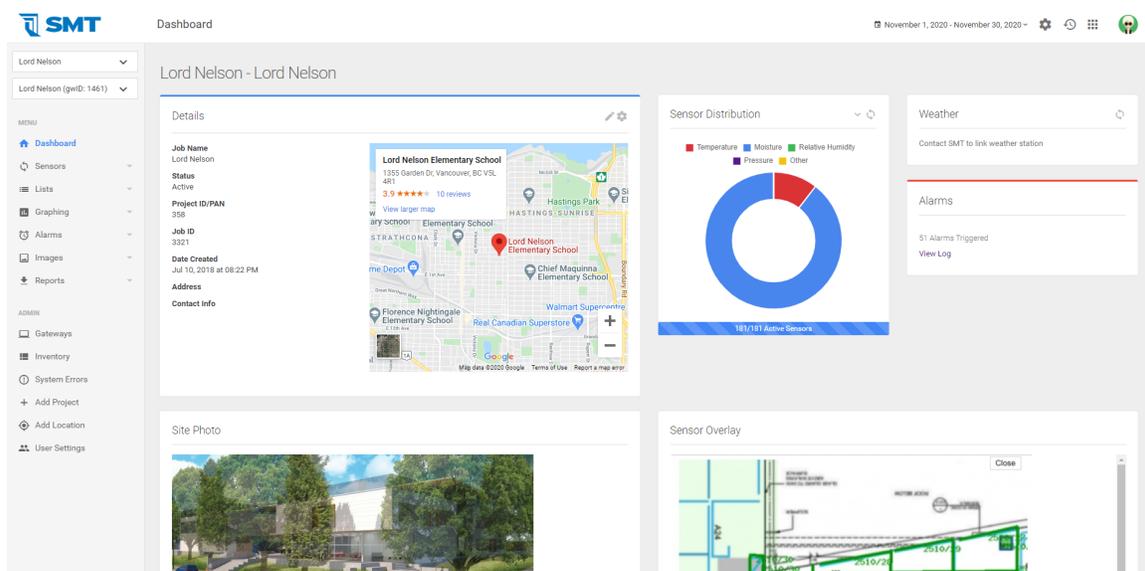
FutureCast Active can monitor the roof assembly for moisture from the moment it is installed, and SMT recommends that the system is activated as soon as possible so that it can be used as construction is ongoing.

FutureCast creates a low voltage electrical field on the wet side of the waterproof membrane, and takes capacitance-based measurements to locate areas where a fault in the waterproofing treatment is allowing a path through to the conductive structural element below. Once this data has been collected, it is uploaded via the Building Gateway to SMT Analytics - our proprietary platform for data analysis and visualization.

Analytics Centre

FutureCast Active grants 24/7 access to the Analytics Centre platform where building owners and maintenance managers can view live data. This includes the raw data readout for each sensor, as well as sensor status. Various backend functions can also be performed from the Analytics Centre, and SMT offers training and support for clients who seek this level of control and customisation.

The Analytics centre runs data from the Digistar sensors through proprietary algorithms which weight various factors to isolate readings that warrant further investigation. This data can be plotted onto a membrane integrity “heat map” for convenient reporting.



Above: Analytics is an easy to use platform for viewing your FutureCast Active sensor data and generating reports.

Alarms

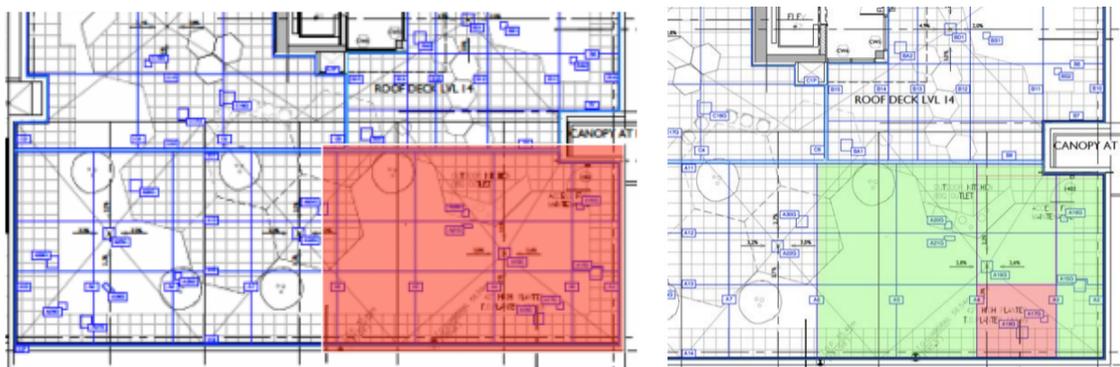
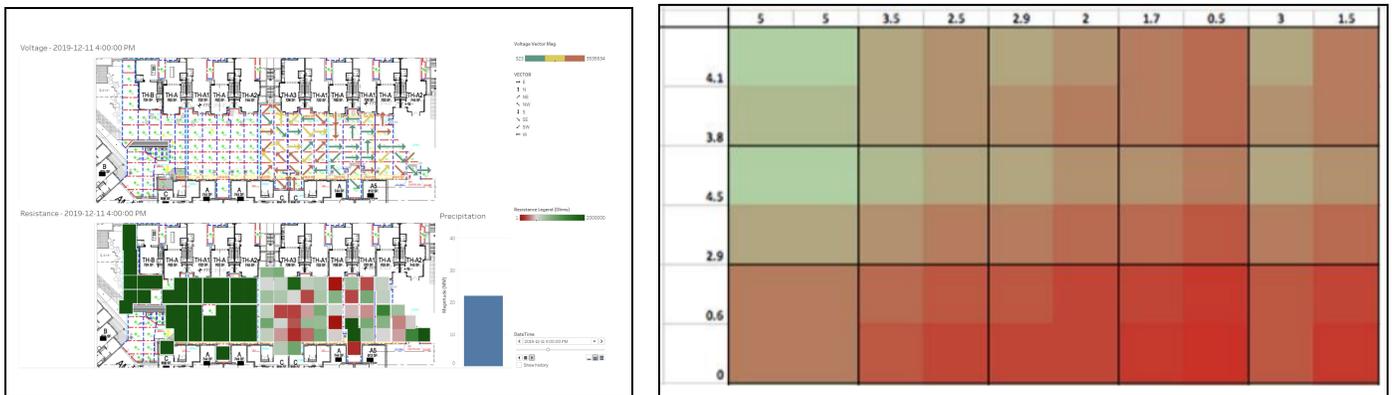
SMT can assist with setting alarm thresholds for each roof zone. FutureCast Active requires a period of calibration on an inverted roof in order to acquire reading under various seasonal conditions. Once calibrated, the system is triggered by readings that are anomalous or hit certain thresholds, and sends alarms to maintenance managers or building owners. Alarms can be sent via SMS or email, or directly into a Building Management System (see integrations later in this document).

Reports

SMT can issue a Basic Report, a snapshot of the current integrity of the waterproofing treatment. This can be used on a routine basis for maintenance planning, or else as required for investigative purposes.

An Advanced Report will take into account historical data of differential voltage in varied conditions over time, showing a trend that can be used to more accurately locate areas of concern where the waterproof membrane may have failed.

See below for sample reports:



Above: The "heatmaps" show visually where data suggests membrane integrity is less than optimal

FutureCast[™]

PASSIVE

PASSIVE SYSTEM OPTIONS

SMT heavily recommends an active monitoring system for round-the-clock intelligence on the health of your waterproof membrane. We do understand that some clients will not choose active monitoring, and SMT offers options for a Passive System.

FutureCast Passive is a Leak Detection System that does not feature any active monitoring electronics or data uplink. The initial phase of installation is the same as FutureCast Active, however the sensors are left dormant beneath the overburden. In this configuration, the sensors are connected to cables, which are routed to deck level junction boxes and left sealed. FutureCast Passive must be activated manually by an SMT technician; either on a call-out to assist with a leak investigation, or on a scheduled visit as part of a service plan.



Above Left: Cables in a FutureCast Passive system.

Above Right: An SMT Technician visits a site to activate a FutureCast Passive System.

FutureCast Passive Leak Investigation Callouts

When a leak is noticed, SMT should be called right away to activate the FutureCast Passive System. A technician will visit the project site and manually power up the EFT and Digistars in each zone using a portable 12V battery. The technician will then use a portable data acquisition device to take readings from the FutureCast Passive system at each deck level junction box. Once each zone has been activated, SMT will review the data and produce a one-off report showing the integrity of the membrane as determined by a voltage differential assessment.

FutureCast Passive Service Plans

Clients choosing a passive system are encouraged to pick a service plan where SMT will activate the FutureCast Passive system on a scheduled basis. SMT will work with the building owner to find the plan that best suits their needs, however typically four activations per year are recommended. This enables SMT to track very broad trends of moisture content, and produce advanced reports which can guide the planning of proactive maintenance.

NEXT STEPS

This document has given an overview of how FutureCast Active and Passive Leak Detection Systems are configured, installed, and operated to monitor the integrity of the waterproof membrane on inverted roof assemblies.

At SMT we pride ourselves on being professional, flexible, and reliable. Please contact us if you would like any additional information, we would be happy to help.

RFQs and technical enquiries can be directed to: info@smtresearch.ca