Remote Virtual Inspections (RVI): Challenges and Opportunities

October 2021

Table of Contents

Acknowledgments

This report reflects the invaluable contributions of multiple individuals.
We would like to recognize the report's lead authors, Crystal Egelkamp, Building Policy Associate, MEEA, and Moses Riley, former Technical Building Associate, NEEP.

Several NEEP and MEEA staff served key roles in the development of the report, including Alison Lindburg, Senior Building Policy Manager, MEEA, Darren Port, Senior Manager Codes and Standards, NEEP, and Cornelia Wu, Building Policy Manager, NEEP. Research and drones for remote virtual inspection (RVI) call-out box by Jess Gearan, NEEP Summer Intern.

Formatting and edits were provided by Lisa Cascio, Director of Partner Engagement, and Victoria Bradley, Marketing Associate.

NEEP and MEEA would like to recognize and thank members of RVI/Prefab Technical Advisory Group (TAG) for their participation in reviewing this report and providing input into creating this document. These individuals include:

Anthony Zarrilli - Zarrilli Homes
Bobby Campbell - Champion Homes
Brian Bock - Thaddeus Homes
Brian Wolfgang - Pennsylvania Housing Research Center
Devin Perry - National Association of Home Builders
Emanuel Levy - Levy Research Alliance
Heather Cowley- PA Department of Environmental Protection
Jake Wilkinson - Michigan Energy Office
Kevin Rose - National Grid
Mark Willie – TStud & Illinois Green Alliance
Matt Belcher - Verdatek Solutions
Michael Jozwiak - City of Lansdowne, PA
Ryan Colker - International Code Council (ICC)
Ryan Smith - Off-site Construction Council (OSCC)/National Institute for Building Sciences (NIBS)
Stacey Rothgeb - National Renewable Energy Laboratory (NREL)
Tom Bassett-Dilley - Tom Bassett-Dilley Architects
Tom Hardiman - Modular Building Institute/Modular Homebuilders Association

This material is based on work supported by the U.S Department of Energy Office of Renewable Energy (EERE) under the Advanced Building Construction with Energy Efficient Technologies & Practices (ABC) – 2019 Award: DE-EE0009084 “Prefabricated Construction: Guidance, Technical Assistance, and Virtual Inspections”

About NEEP / MEEA

NEEP was founded in 1996 as a non-profit whose mission is to serve the Northeast and Mid-Atlantic to accelerate regional collaboration to promote advanced energy efficiency and related solutions in home, buildings, industry, and communities. Our vision is that the region's homes, buildings, and communities are transformed into efficient, affordable, low-carbon resilient places to live, work, and play.

MEEA is a nonprofit membership organization with 160+ members, including utilities, research institutions, state and local governments, and energy efficiency-related businesses. As the key resource and champion for energy efficiency in the Midwest. MEEA helps a diverse range of stakeholders understand and implement cost-effective energy efficiency strategies that provide economic and environmental benefits.

Disclaimer: NEEP verified the data used for this white paper to the best of our ability. This paper reflects the opinion and judgments of the NEEP staff and does not necessarily reflect those of NEEP Board members, NEEP Sponsors, or project participants and funders.

Executive Summary

Across the country, many state and municipal offices are facing challenges in their building construction divisions. Resources to support code enforcement remain inadequate[1] while shortages of building code inspectors increase. Building construction inspections must keep up with construction demand and meet state and municipal climate and energy goals through compliance with building codes. The COVID-19 pandemic presented an unexpected opportunity to research the potential for remote virtual inspections (RVI) as a possible solution to these challenges.

This brief explores the current use of remote virtual inspections (RVI) and its barriers and opportunities. The report is informed by independent research, interviews with industry professionals, and a collaborative survey effort. A survey was conducted by the project team in collaboration with the International Code Council (ICC). The ICC had previously issued two surveys regarding remote inspections – one in April 2020 and a follow-up in September 2020 – and the project team's survey was a follow-up to these, released in February 2021. The survey was designed to address two different audiences: one set of questions was tailored to code officials and inspectors (referred to as "jurisdictional responses and interviews"), and the other was tailored to contractors, builders, and manufacturers (referred to as "contractor responses and Interviews"). The project team also conducted personal interviews with the same industry groups. Many of them had also taken the survey or were a part of the project's Technical Advisory Group.

A joint survey was also conducted by the project team in collaboration with the International Code Council (ICC) to inform the team's research and this paper, targeting additional responses from code officials, builders, contractors, and manufacturers. The survey provided 158 additional responses from code officials and 28 contractor responses; of those contractor responses, 12 volunteered contact information for follow-up interviews, although only one builder interview could be completed. In additional outreach to builders and contractors in the Midwest region, no respondents had any experience with off-site construction or remote inspections. Further outreach to builders and manufacturers is being considered, and any data obtained will be issued in a subsequent report.

This brief is a compilation of the project team's research and analysis. In summary, the use of RVI is increasing and most responses to its use seem positive. Identified challenges include maintaining RVI accuracy, constraints in resources and consistency in practices, personal preference and staffing challenges, and technological/internet issues. The many benefits include saving cost and time, improved health and safety, improved technology and record-keeping, and expanding the reach of code compliance geographically and conceptually. All signs seem to indicate that the future of RVI is malleable and will be integrated in a hybrid fashion in a post-COVID world.

Project Team: The project team consists of Northeast Energy Efficiency Partnerships (NEEP) and the Midwest Energy Efficiency Alliance (MEEA), in collaboration with the International Code Council (ICC). The report, research, surveying, and Technical Advisory Group (TAG) coordination are funded by the United States

[1] https://www.energycodes.gov/energy-efficiency-field-studies

Department of Energy (U.S. DOE). The information and views expressed herein are solely that of NEEP and MEEA.

Introduction

Building inspections are critical in ensuring that homes and buildings meet communities' expectations for safety and efficiency as outlined in their building codes. Code officials conduct building code inspections during and after the construction of a building. Building inspections may be performed by third-party inspection services but are most often performed by jurisdiction staff.

Historically, building inspections have been conducted on-site and in-person. New technology and platforms have made it possible to conduct code inspections remotely, either partially or entirely. This practice, referred to as remote virtual inspections (RVI) or just "remote inspections" or "video inspections," uses video cameras, still photographs, and video networking software (often in combination) to conduct a home or building inspection remotely rather than conducting it on-site.

Remote virtual inspections typically connect the contractor and code official via video networking software at a scheduled time and follows a list of areas in a structure that must be checked for compliance with relevant building codes. The contractor (or individual on the construction site in charge of virtually touring the inspector around the structure) follows the inspector's guidance in showing them what must be checked, just like a regular inspection, during which the inspector will verify compliance of specific items.

The COVID-19 pandemic hampered progress on many construction projects by limiting the ability to perform on-site inspections due to social distancing requirements. As a result, there became an increased need for RVI since it allowed inspections to take place remotely while maintaining social distancing.

The implementation of RVI, however, has been challenging. Few existing standards and best practices are available for this inspection method, and concerns exist about whether RVI is a viable and trustworthy practice for building inspections. In response to the increased need for RVI due to COVID-19, the International Codes Council (ICC) promulgated best practices and considerations for the successful use of remote virtual inspections in May 2020.[2] In December 2020, the Code Council issued follow-up guidance for code departments to establish programs that use electronic permitting and plan review and RVI.[3] Not many other resources were provided to aid building officials with RVI, fueling code officials' hesitancy to adopt RVI practices.

Current RVI Use in the United States

Survey results indicated that while RVI use isn't yet widespread in the United States, it is being used predominantly in the West and Southern regions of the country, especially in California and Texas (Figure 1; note that respondents were self-selected and self-reporting). When asked if their department currently performed inspections remotely or in-person, jurisdictional responses indicated that 59 percent of jurisdictions still performed only in-person inspections. In comparison, 39 percent responded that they did a mix of in-person and remote inspections. Only two percent of jurisdictional respondents stated that they performed only remote inspections, with those responses coming from the South and West regions of the U.S. (Figure 2). A caveat to

[2] ICC's Recommended Practices for Remote Virtual Inspections (RVI)
[3] Model Program for Online Services: Permitting, Plan Review and Remote Inspections

these questions is that they did not specifically ask when these permitting and inspection processes began or whether they started before or due to the COVID-19 pandemic. Additionally, besides survey results, it is unknown why results indicated that remote inspections are slightly more common in the West and Southern regions, and further research is necessary.

Figure 1

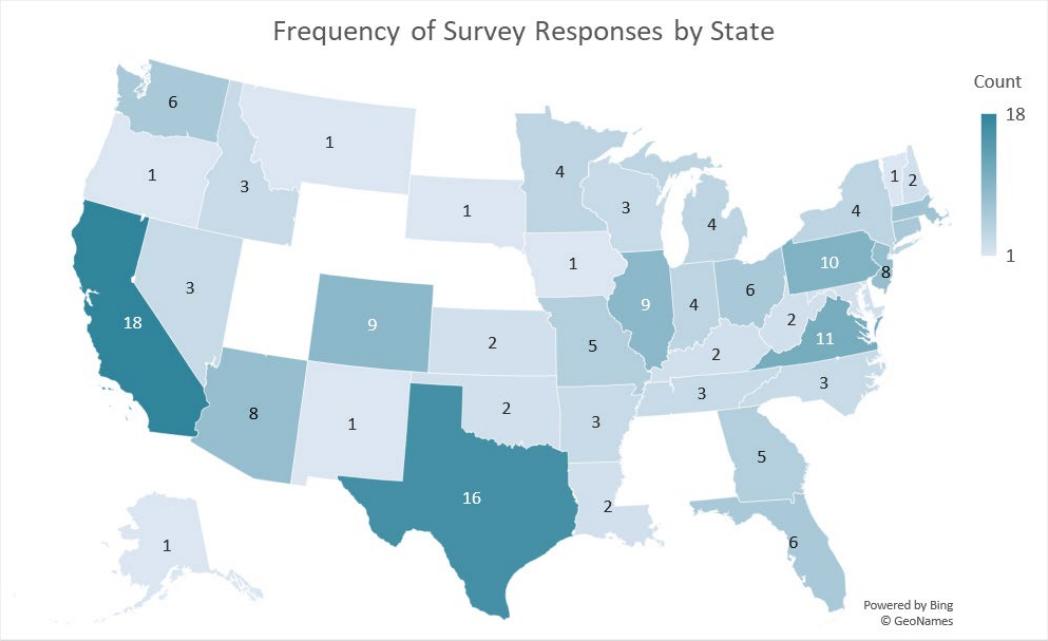
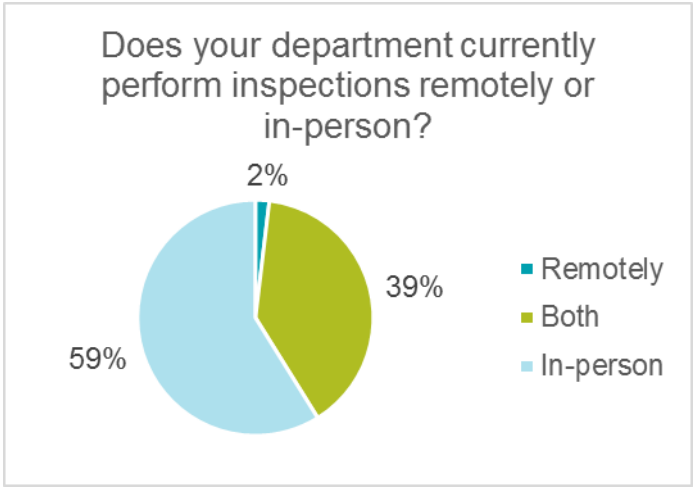


Figure 1, Frequency of Survey Responses by State of Combined Jurisdictional and Contractor Responses

Figure 2

Figure 2, Survey Jurisdictional Responses of Current RVI Use



Furthermore, contractor responses indicated that of the jurisdictions in which they work, 18 percent offer remote inspections (Figure 3). Moreover, in the two previous surveys that the ICC issued in April and September 2020 regarding remote inspections, code officials noted that 66 percent and 47 percent of some or all of their employees were conducting plan reviews or inspections remotely (respectively)[4]. In comparison, this was only 41 percent in the project team survey, indicating that remote inspections were decreasing throughout the pandemic. These survey results are taken together to imply that although remote inspections spiked during the beginning of the pandemic, they decreased throughout the year and are still not yet widely used or incorporated in the U.S.

Figure 3

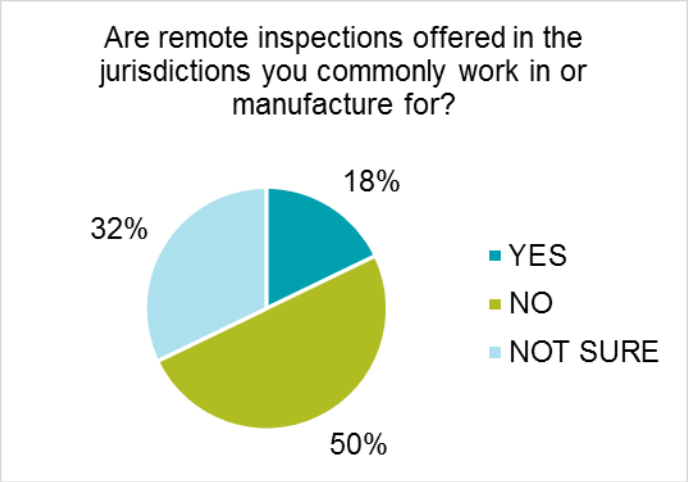


Figure 3, Survey Contractor Responses of Current RVI Use

Similar to survey results, interviews revealed that if a jurisdiction began to use RVI, it was most likely due to the COVID-19 pandemic. Most jurisdictions stated that they transitioned to using this practice by inspecting small projects remotely and then later moved to inspect larger projects.[5] An example of this is North Las Vegas, which moved towards 100 percent RVI when the pandemic hit so as to maintain its construction availability for the community. The city began with smaller projects, such as water heater replacements and AC change-outs, and then progressed to larger projects.[6] Jurisdictional survey responses also revealed that smaller projects were more commonly inspected remotely, with re-inspections, water heaters, and HVAC change-outs selected frequently (Figure 4). It is important to note that North Las Vegas mandated the video part of the inspections, which helped increase RVI use.

[4] ICC's Follow-up Survey: Building Safety and COVID-19 Analysis of code department operations in the United States during the pandemic, December 17, 2020
[5] Doug Harvey, Building Official, St. Lucie, Florida
[6] Valarie Evans, Building Official, North Las Vegas, Nevada

Figure 4

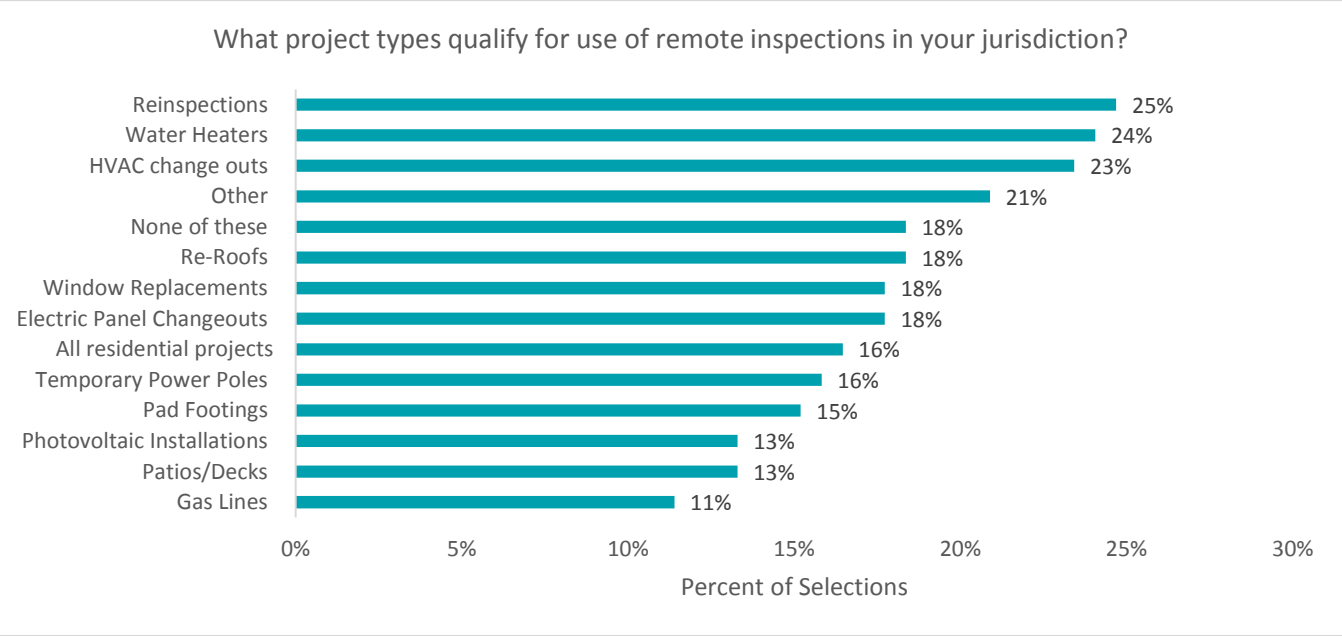


Figure 4, Survey Jurisdictional Responses of RVI Project Types

Many communities did not make the transition to RVI during the pandemic. Some jurisdictions completely closed during the initial pandemic shutdown, whereas some remained open, performing inspections but not having their offices open to the public. In some instances, construction reviews still occurred in person, and inspectors were issued masks, gloves, and hand sanitizer. In state-owned buildings and schools in Iowa, inspections were still performed on-site by sectioning off parts of the building to abide by social distancing requirements.[7]

Electronic Plan Review

Although RVI is not yet used widely across the U.S., survey results and interviews revealed that electronic plan submittals and reviews (EPR) were more common. When asked if they require electronic plan submittals, most jurisdictional respondents said they accepted EPR on at least some projects: 34 percent responded that they only accepted electronic, another 34 percent reported that projects could be submitted for either paper or electronic plan review, and nine percent only allowed electronic submittal for specific projects. Twenty-two percent of jurisdictional respondents answered that they only accepted paper submittals. Some jurisdictions used EPR procedures before COVID-19, making it easier for them to move to RVI. Most jurisdictions that performed RVI were already accepting electronic plan submittals and reviews, showing that there may be a link between these processes. For example, Holden, Maine, was performing EPR a year-and-a-half before moving to

[7] Dave Ruffcorn, Building Official, Iowa

some RVI due to COVID-19,[8] and Corning, New York was already conducting RVI and EPR for several years before COVID-19.[9]

Respondents gave many benefits for electronic plan review. EPR software makes it easier for code officials to check plans for errors and helps them to avoid making human errors, which helps them avoid safety risks and be more efficient. Jurisdictional survey respondents also noted that EPR allows code officials to quickly mark up plans to highlight errors or areas of concern, which helps inspectors respond faster to contractor concerns and questions. Additionally, without the need to print plans, EPR saves developers, designers, and contractors time and money.

Like remote inspections, some code officials and contractors are hesitant to use EPR and prefer paper plan reviews.[10] Some plan reviewers stated that building plans were more challenging to read on a screen. Jurisdictional survey respondents reported that barriers to EPR include a lack of integration with city or departmental software (35 percent), access to new technology (34 percent), and the ability to procure required equipment (30 percent). Many code officials cited a need for standards, training, software, hardware, and support to increase the use of this process.

Benefits of RVI

While exploring the current use of remote inspections in the U.S., several benefits to the practice became evident, including the ability to conduct more inspections on a given day, improved record-keeping, and increased safety of inspectors. Jurisdictional survey respondents highlighted a few more: the ability to perform RVI anywhere with a strong internet connection, less time required to perform an inspection and increased efficiency with minor projects, and increased savings in vehicle fuel and costs.

Cost and Time Savings

A shrinking workforce has forced a heavier workload with fewer resources onto code officials and building inspectors. RVI presents an opportunity to meet some of this increased demand by allowing inspectors to cut travel time and save costs on travel and accommodations. Jurisdictional respondents suggested that video inspections require less time to conduct than typical inspections. It is unknown how remote inspections affect builder and contractor scheduling and will need further research.

Improved Health and Safety and Time Savings

Using RVI can increase the safety of inspectors. For example, inspectors may typically be required to climb a ladder to check attic insulation or inspect flashing on a roof. Depending on the size of the structure, not only can this take time but it can also pose a risk to code officials and can delay the completion of a project until they can safely perform the inspection. As an alternative, some jurisdictions have adopted the use of drones to inspect roofs for code compliance. Rather than having an inspector climb up a ladder and walk around a roof, an inspector could fly a drone above the roof with a camera taking pictures of the structure and saving them into a project file. One interviewee expressed how older building officials are at increased risk of injury climbing scaffolds or ladders to inspect structures. Another expressed that remote inspections allow them not to worry s

[8] Ben Breadmore, Building Official, Holden, Maine
[9] Steve McDaniel, Building Official, City of Corning, New York
[10] Dave Ruffcorn, Building Official, Iowa

during an inspection."[11] When some jurisdictions began to perform RVI due to the COVID-19 pandemic, they kept their inspectors and contractors safe and healthy while being socially distanced.

Drones for RVIs

Drones offer an ideal opportunity for remote inspections due to their ability to quickly capture detailed footage of areas that may be time-consuming and dangerous to physically access, especially if climbing or crawling is involved. They can be controlled at varying distances from the inspection site by a human pilot. In addition to images and video, some drones utilize mapping tools, GPS units, and thermal cameras that help permanently document the inspection area.[1]

The use of drone technology has seen some uptake outside of the United States; some high-rise buildings in Dubai, United Arab Emirates have been using drones in construction and inspection practices. Incorporating drone technology into inspections can be challenging in the U.S. due to FAA regulations that often prohibit drones from flying without express permissions, and on the few times when those permissions are obtained, often with time and operation restrictions. Limitations in drone range distance can also pose an issue. Because of this, some jurisdictions have found that the current barriers to drone technology potentially outweighs some of the benefits. Additionally, drones themselves are expensive, and require technical skills, specialized training on hardware and software, and in some cases, operator licensing. Drones also require inspectors to be conscious of private property and search laws. The International Code Council is currently convening stakeholders to attempt to address these and other RVI barriers.

Eversource, New England's largest energy provider, uses drones to inspect their electric lines. Drones provide a higher-quality inspection and reduce the need for helicopters and on-foot inspections in rugged terrain. A drone's ability to complete accurate power line damage assessments and send critical data to restoration planners allows Eversource to respond more promptly to emergencies.[2] On the municipal level, cities and governments have utilized drones differently, from accessing traffic patterns and building inspections (roof, facade, HVAC replacement, thermal imaging). In 2015, Somerville, MA, called on Above Summit LLC to virtually inspect 30 at-risk public properties for excess snow load.[3] Drones may become more and more commonplace in remote inspections as their benefits seemingly outweigh their downsides in the eyes of many stakeholders.

[1] Tech 101: Construction drones

[2] https://www.eversource.com/content/ct-c/residential/outages/avoiding-an-outage/drones

[3]https://abovesummit.com/as-blog/2015/2/20/somerville-roof-inspection

[11] Dean Thomas, ICC Master Code Professional

Improved Technology and Record Keeping

New equipment and technologies, such as improved mobile devices, tablets, and cameras, can make it easier for code officials to see job sites virtually. This technology, along with various video networking software, allows code officials to stay in contact with the job site. One personal testimony from a contractor expressed how their use of RVI in Florida has been a great experience and could even lead to increased quality of inspections because of improved record keeping.[12] Although some jurisdictions require a paper copy of plans, some building officials still ask for an electronic copy to store it for the project. Building upon this, if remote inspections are recorded and saved to a project profile, they could be referenced later for compliance and even used for training purposes.

Expanded Reach

RVI reduces the need for in-person travel, leading to an expanded reach of inspections. Less travel time means more flexibility in schedules to conduct more daily inspections. RVI also expands inspections geographically to places with few inspection resources or rural areas that may not typically see certain inspections often, if at all. RVI could also lead to increased adoption of codes in areas that currently don't have them due to limited resources. For example, in some states, cities with populations below a specific threshold are not required to adopt the energy code due to their likely limited enforcement resources. RVI would allow for inspection of these codes more efficiently, potentially creating an opportunity to expand the adoption of codes in these areas. In jurisdictions with limited resources, state building departments could offer to inspect via RVI to support those jurisdictions.

Challenges of RVI

Despite the positive benefits of RVI, challenges still exist. These challenges have caused many to be hesitant to adopt this practice. Jurisdictional survey respondents cited the inaccuracy of remote inspections (59 percent; the majority of responses coming from the West and Northeast regions), lack of communication between contractors and builders and code officials (39 percent), and lack of consistent universal standards (35 percent) as the most significant barriers to implementing RVI (Figure 5).

[12] Anthony Zarrilli, Zarrilli Homes

Figure 5

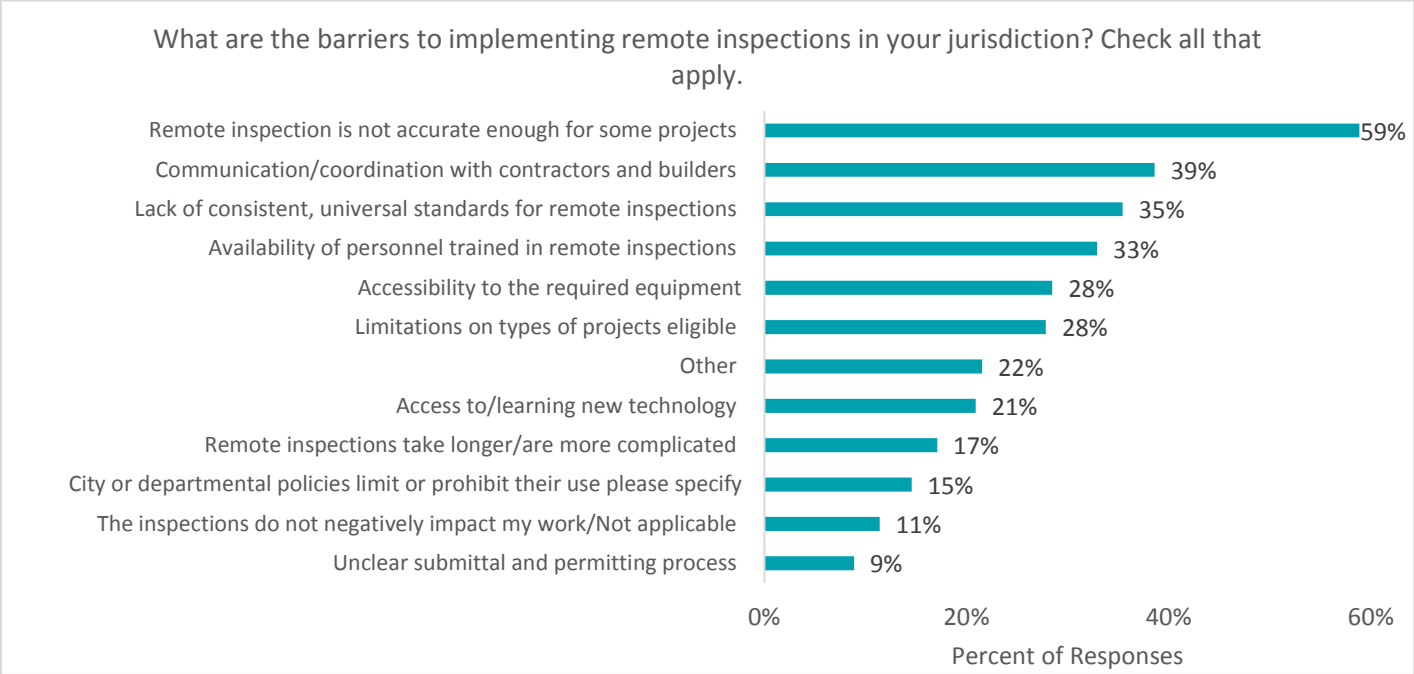


Figure 5, Survey Jurisdictional Responses to Remote Virtual Inspections Barriers

RVI Accuracy and Data Falsification

Although remote inspections may be more efficient than on-site inspections in some ways, code officials (in both the survey and interviews) stated that they are not accurate enough to fit the needs of every project. Many reported that a remote inspection does not allow code officials to visually see everything in a building they usually see during an on-site inspection. Lack of details can be for various reasons: camera equipment not being able to pick up specific details, pictures being provided instead of videos, and contractors not fully showing everything during a video inspection.

An example provided during jurisdictional interviews was that a remote inspection may identify the type of insulation but would not accurately assess the R-level of that insulation or the quality of its installation. One code official mentioned that remote inspections could miss OSHA violations, general site cleanliness, and possible safety violations noticed while visiting a construction site.[13] Another code official expressed that they would never use remote inspections for complete building inspections but instead use it for product installations or replacements.[14] One jurisdictional survey respondent wrote that "you can't take the human element [out] of an inspection no matter how the technologies advance." It is essential to note that inspection accuracy is critical at finding potential issues, and RVI can lead to better documentation practices (see the section on Improved Technology and Record-Keeping).

[13] Steve McDaniel, Building Official, City of Corning, New York
[14] Anthony Zarrilli (Zarrilli Homes), Sam Palmer, Matt Brewer, and John Cosomitas

As stated earlier, remote inspections can incorporate photographs. Photos are usually taken on-site in conjunction with a live remote inspection and emailed to code officials after the inspection or submitted to clarify certain aspects that weren't clear during the live video inspection. One person that was interviewed mentioned concerns about the accuracy of submitted photos and ensuring contractors were not using photographs from other projects,[15] especially if only photos were submitted to pass an inspection. In response to this, other code officials mentioned that all photos should be verified using time-stamps to match project location, and that geolocation should be used in live videos to confirm location; without this verification, an on-site inspection would be necessary. Most jurisdictional interviewees agreed that, ideally, photos should only be used to supplement a live inspection and that more awareness is needed around this topic in the building inspection industry. Despite concerns with data accuracy and falsification, none of the stakeholders interviewed said they had personally experienced anyone purposefully trying to provide false or inaccurate data with RVI.

Resource Constraints and Lack of Consistency

Lack of consistent guidance rose as a considerable challenge to adopting and implementing RVI. Due to a lack of standards, training, and resources around remote inspections, many jurisdictions created their own processes and experimented with different resources and technologies. Creating their processes resulted in jurisdictions losing time and money while experimenting, creating inconsistency in how remote inspections are performed around the U.S.

In interviews, several code officials mentioned that training on electronic permitting and remote inspection procedures would have helped them better understand these processes and put proper procedures in place. Additionally, having video tutorials on the software and jurisdiction procedures would have helped the contractors with electronic permitting submittal and overall code compliance.

An important note about training is that depending on the size of the jurisdiction, time out of the office and costs associated can be a major factor when budgeting. One code official noted that, "a smaller jurisdiction attending a multiple day in-person training with travel, lodging, and food, has the potential to be very expensive and while $500 would cover some of it, it may not be enough to get the person to the training."[16] Offering the training on RVI (or other code issues) in a virtual format can expand the likelihood of a code official attending that training.

Personal Preference and Staffing Challenges

Personal preference and issues with jurisdictional staffing pose another challenge to widespread RVI use. Some code officials are more hesitant to use new technologies in the remote inspection process and prefer to perform in-person inspections.[17] Though this may signal a lack of understanding of RVI and necessary training, many code officials lack time to attend training, especially if they work part-time or their departments are already understaffed.

---

[15] Benny Zank, Engineer and Consultant, Energy Solutions
[16] Ben Breadmore, Building Official, Holden, Maine
[17] Dave Ruffcorn, Building Official, Iowa

Some jurisdictions have passed inspections off to other trained officials, like fire inspectors, since they may not have had staff within the department to step up or have had difficulty hiring for the position from outside the organization.[18] A few code officials noted that remote inspections still take time and may even result in an on-site inspection, especially if the remote inspection doesn't line up with a contractor's schedule or software or connectivity issues. Additionally, as many code officials retire, it creates a "big gap in civic positions," making it difficult to "retain that extensive knowledge of the retiring code officials."[19] This indicates a concern that long-standing knowledge and experience of current in-field inspectors might not be incorporated with RVI use.

Many respondents reminded the team that building officials' responsibility keeps buildings, and more importantly, the occupants inside them, safe. Although remote inspections sound like the future, some code officials noted that they can end up removing the in-person interaction of an inspection. Some code officials use in-person inspections to teach contractors and homeowners about the building codes and explain their reasoning. An argument can be made that remote inspections remove the critical relationship between the inspector and customers.[20]

Technological Issues

With the many technologies that make RVI feasible come varied technological challenges as well. There is an overwhelming amount of equipment and software needed to conduct RVI. Although this provides a variety to choose from, currently, most jurisdictions must research the appropriate software and equipment that is best for them to use for remote inspections. With resource and time constraints, some jurisdictions don’t have the time for this. Jurisdictions also sometimes use various software or platforms to accommodate the needs of customers or contractors, further requiring jurisdictions to learn multiple platforms. Additionally, this technology is not available to all jurisdictions. Many building officials don't have access to proper quality cameras and video equipment to perform remote inspections. Another significant barrier some jurisdictions face, especially in more rural areas, is access to reliable high-speed internet. Due to poor internet connection and cell service, a building official noted that "in more rural settings, it would be difficult to do live remote inspections."[21] Furthermore, if there are technology or software connectivity issues or required device upgrades,[22] these issues could take up much time and possibly result in an in-person inspection if the issues are not resolved.

Future Opportunities for RVI

Currently, RVI may not be utilized extensively, but this creates many opportunities for increased engagement and support to grow its use.

Technology and Tools

Jurisdictional respondents offered many ideas on what tools or technologies would enhance their ability to provide or perform remote inspections (and electronic plan review): most selected an intuitive software and user interface between code department and contractors (53 percent), followed by an integrated tool for

[18] Ben Breadmore, Building Official, Holden, Maine
[19] Ben Breadmore, Building Official, Holden, Maine
[20] Patricia Chawla, Building Official, City of Austin, Texas
[21] Matt Belcher, Verdatek Solutions
[22] Ben Breadmore, Building Official, Holden, Maine

electronic permitting, plan review, and inspection (42 percent), and a project management tool or platform that would allow collaboration and documentation capabilities (34 percent) (Figure 6).

Figure 6

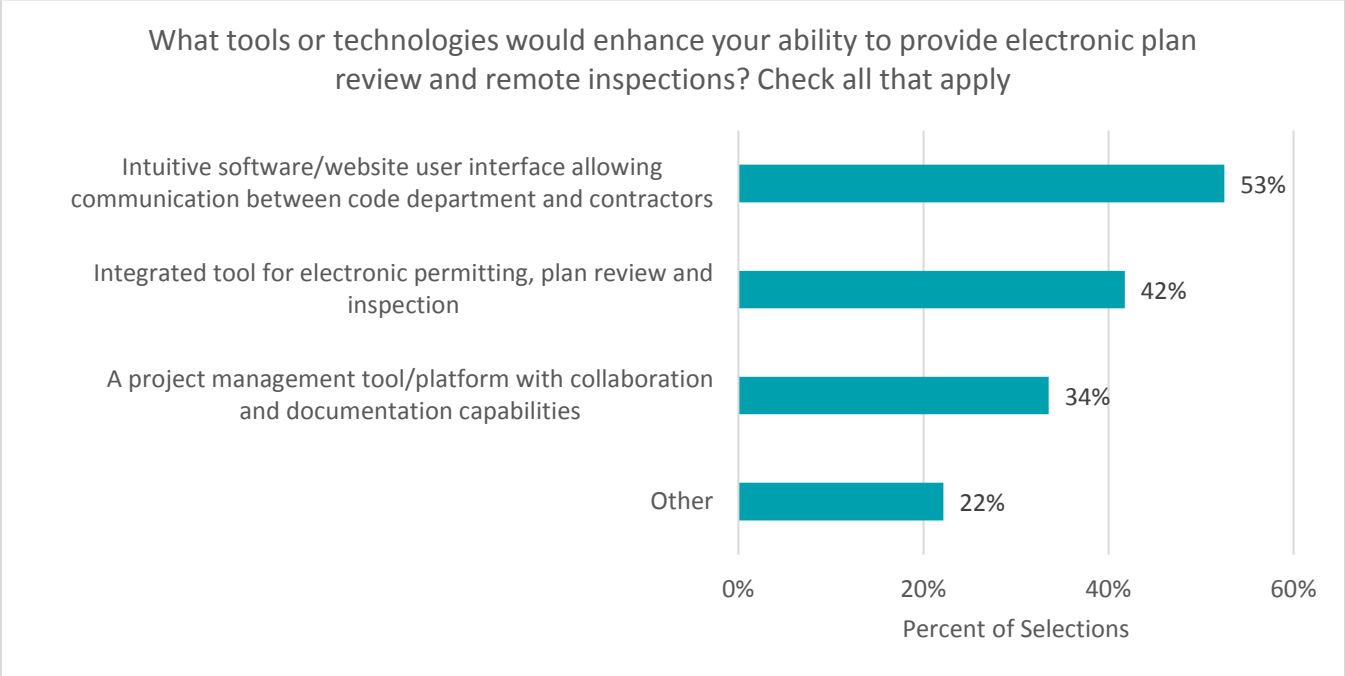


Figure 6, Survey Jurisdictional Responses to Remote Virtual Inspections Technologies

Some jurisdictional respondents wrote in additional tools that would help them, including funding, training, additional staffing, and a request for software that works with existing systems rather than replacing or purchasing new ones. Additionally, more research needs to be done on the various equipment and software available for remote inspections and the affordability of said equipment (i.e., tablet vs. drone). This research would shed light on the most affordable equipment and software, and help decipher how many jurisdictions can afford to switch to the remote inspection process.

Standardized Process

Although the ICC released recommend practices for remote inspections, and some new standards will likely be released in the future,[23] jurisdictions still emphasized a lack of standards for RVI as a primary opportunity for assistance. A lack of consistency in how they are performed creates challenges for contractors and other parties who work with various jurisdictions on multiple project types. Even though remote inspections will not become completely uniform throughout the U.S. anytime soon, jurisdictions must have a process to reference and replicate. The existence of a consistent process may result in an increase of remote inspections[24].

[23] NFPA 915 Proposed Standard for Remote Inspections; ICC/RESNET Standard on Remote Virtual Inspections for Energy and Water Use Performance of Buildings.
[24] David Spencer, Building Official, Chelan County, Washington

Training and Funding

As mentioned in the "Challenges to RVI" section, many code officials specified a need for training and resources around remote inspections. To maximize RVI effectiveness, it was reported that any training or resources should be easy for code and building officials to find, are offered in-person and virtually, and are supplemented with funding to attend (or provide funding to cover staff hours while attending).

Training should cover topics such as a standard process for RVI that many jurisdictions could follow, provide examples of what certain jurisdictions have done and what has been successful for them, which software and equipment are the best to use, and address any shortcomings in the RVI process. Additionally, it's essential to ensure contractors, builders, and manufacturers have access to training about their specific industry to understand how remote inspections affect them and how to comply with these practices.

Workforce Development

An aging and shrinking workforce is a significant issue in the inspection industry that must be addressed to increase or improve the use of RVI. Many code officials are retiring or are not equipped to adapt to new online technologies and equipment. Alternatively, RVI presents an opportunity to diversify and expand the workforce. The field needs more people, and RVI could bring people from different backgrounds, ethnicities, age groups, and trades. A few opportunities to incorporate RVI into workforce development could include the following:

- A training program that allows code officials to learn from one another, especially from those with decades of experience, would greatly help those coming into the field and help create a more seamless transition to using RVI;
- A program that reaches university and college students might greatly increase interest in this field among younger people, which might expand RVI use (since younger people are typically more comfortable with new technologies);
- A program that teaches recommendations,[25] processes and standards for RVI;
- A program that teaches electronic plan review, in addition to its comparisons with as-built inspections; and
- A program that prioritizes building science and energy code inspections (such as the water and energy remote inspection process[26] under development by RESNET and ICC).

Resource Sharing

Some code officials mentioned that they were unsure where to find information on remote inspections. A common theme is that they look to other jurisdictions or industries for experience[27] or questions about RVI technologies.[28] It would likely benefit code officials to have a centralized resource hub of information on RVI, such as fact sheets, checklists, testimonies, contact information, and connection to a group of people they can talk to about issues. Many code officials also mentioned that they would be willing to meet with other building officials across their region and discuss issues or share information about what has helped them implement RVI

[25] https://iccsafe.realmagnet.land/whitepaper-download
[26] https://www.resnet.us/articles/resnet-and-icc-re-ansi-candidate-standard-on-remote-virtual-inspections/
[27] Valarie Evans, Building Official, North Las Vegas, Nevada
[28] Dave Ruffcorn, Building Official, Iowa

practices. MEEA has seen success with increasing energy code compliance through this type of statewide resource-sharing and network collaboration, and believes that model could also apply to the topic of remote inspections.

Technological Support for RVI Software and Platforms

Many jurisdictions mentioned the need for IT support while using RVI, and as RVI software and platforms expand, jurisdictions will need more help managing those systems and solving issues. In jurisdictional interviews, one building official using RVI stressed that "IT support staff is crucial to help design and maintain the EP [electronic plans] and RV platforms."[29] Some jurisdictions mentioned that having contractors help test out platforms and undergo training for said platforms would greatly help and save code officials some time.[30] Several code officials also stressed the need for universal RVI software. They stated that a specific remote virtual inspection software could remove some of the barriers and uncertainty that some jurisdictions face and help increase the use of RVI.

Additional Research

A final opportunity for more research is around certain aspects of RVI. Accurate data is needed on where and how RVI is conducted throughout the U.S. which can be used as a baseline to determine which strategies help improve those rates. Research is also needed on whether RVI can handle all aspects of all inspections, including whether a job site is up to OSHA standards, and could also possibly be a tool to assess the accuracy of on-site inspections.

A final concern that will need further research is outside contractor inspections. An anonymous code official that was interviewed recalled their experience working with outside contractor companies. When bidding for projects, these companies often emphasized that they can perform inspections "faster and cheaper than in-house staff," which could deter existing workforce and create gaps in the inspection process, especially since they typically work separately from the rest of the jurisdictional staff and sometimes not even in the same community.

The lack of interaction between outside contractors and public employees can result in knowledge gaps that negatively affect both the plan review process and the inspection process. This official also mentioned since there is very little regulation of the industry, it is up to each private company to decide whether or not to offer the necessary reference materials and code training to their staff. Currently, these companies do more EPR than RVI, but further research may be needed on private third-party inspection companies to ensure that future third-party RVI inspections are performed to the actual code.

Conclusion

The Future of Remote Inspections: A Hybrid Approach

All signs seem to indicate that the future of RVI is malleable and will be somewhat of a hybrid integration.

---

[29] Valarie Evans, Building Official, North Las Vegas, Nevada
[30] Steve McDaniel, Building Official, City of Corning, New York

The use of RVI will likely decrease after the pandemic is over, unless intentional support and resources are provided. When asked if they would continue to conduct remote inspections and electronic permit reviews after the pandemic was over, survey results indicated some trust in the method, with 41 percent of jurisdictional respondents (Figure 7) and 43 percent of contractor respondents replying yes (Figure 8). The more significant proportion of responses were from the West and South regions.

Figure 7

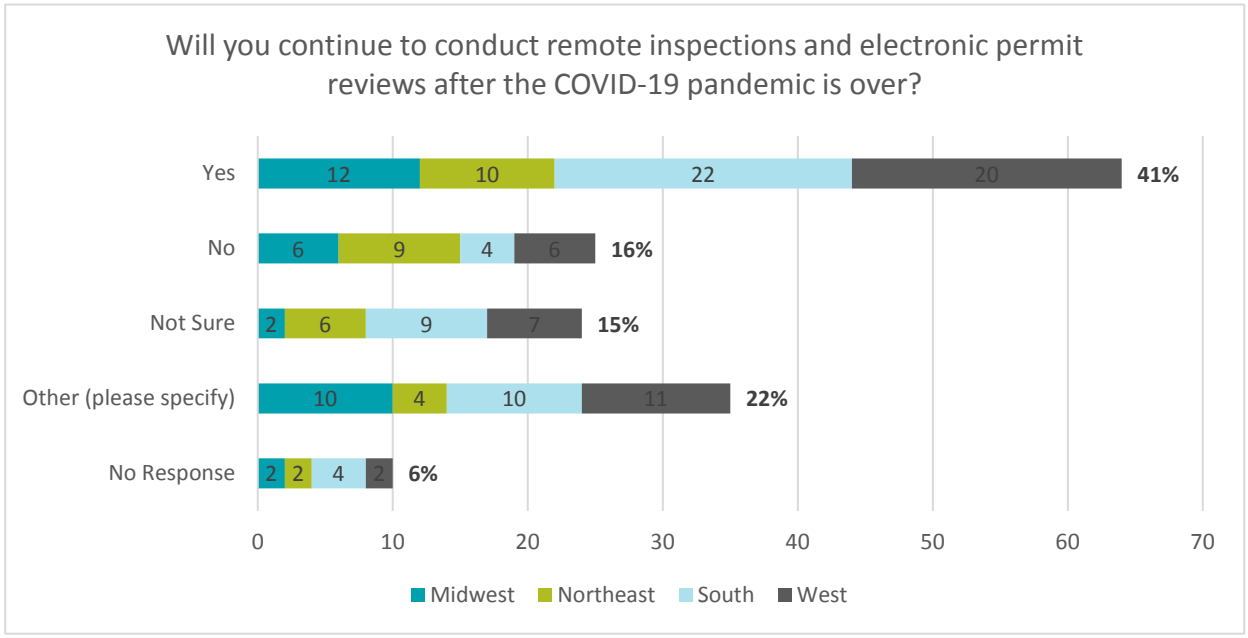


Figure 7, Survey Jurisdictional Responses to Post-COVID RVI and EPR

Figure 8

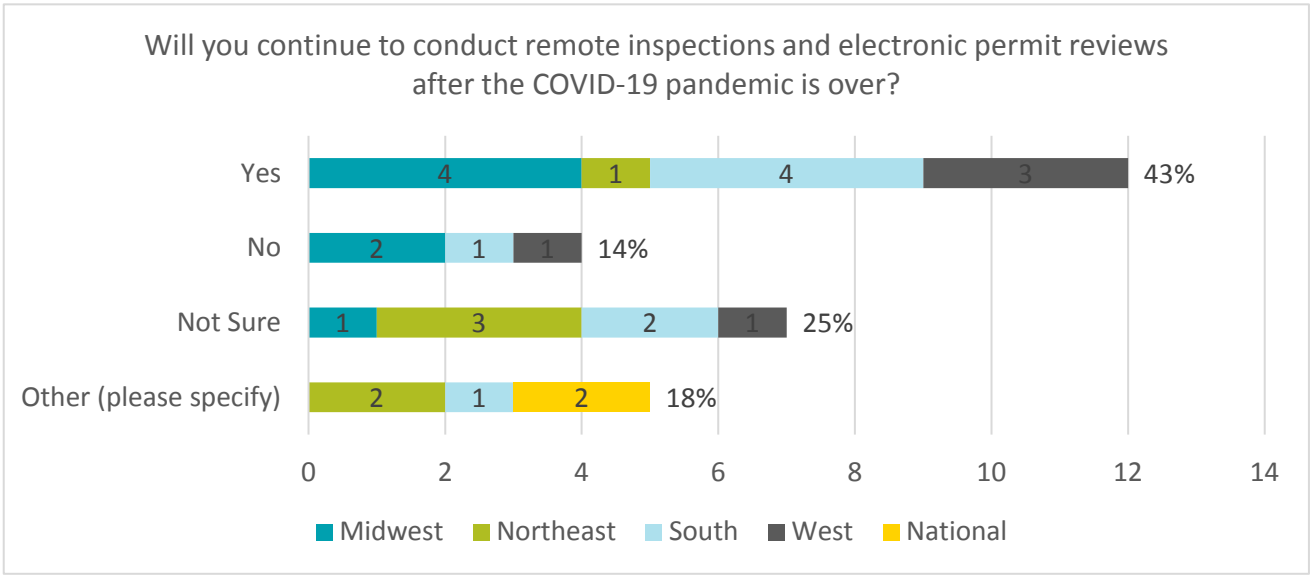


Figure 8, Survey Contractor Responses to Post-COVID RVI and EPR

This question did not separate electronic plan review from remote inspections, so jurisdictional respondents could have meant that they would continue to use EPR but not RVI. In support of this, many jurisdictional respondents wrote in to the open response option that they would continue to use EPR but not RVI; and that they would use remote inspections on a case-by-case basis (e.g., re-inspections, final inspections, corrective actions). Others said that remote inspection is best used for smaller projects or as a tool to supplement an on-site inspection. Similarly, contractor respondents wrote that they would continue to use electronic plan review but not remote inspections.

With support, the use of RVI could expand and provide many benefits to the construction industry. Rather than seeing remote virtual inspections as an all-or-nothing approach, it could be seen as a tool in certain circumstances and for specific projects. It might be fruitful to consider a hybrid approach based on need and circumstance. While standardization is needed, there is likely no one-size-fits-all solution. Every jurisdiction is different; some may perform inspections 100 percent remotely, while others can only do it partially due to lack of staff, resources, or comfortability. Using a steppingstone approach could facilitate the long-term use of RVI. EPR could help jurisdictions and contractors adapt to new technologies, use RVI for small and easy projects, and eventually transition to RVI with more significant projects. Remote inspections will not be successful in any capacity unless there are structures and resources in place to aid in the enforcement and compliance.