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Construction Vibration Issues
Staff Report

Report Number: 2019-29

Department(s): Planning and Building Services

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Meeting Date: March 18, 2019

Recommendations

1. That the report entitled Construction Vibration issues dated march 18, 2019 be received; and,

2. That staff require vibration impact assessments as part of a complete application for development proposals; and

3. That Council endorse the proposed notice and complaint process identified in this report.

4. That Staff be authorized and directed to do all things necessary to give effect to this resolution.

Executive Summary

Impact of vibrations emanating from construction sites in or adjacent to residential areas has been identified an as issue that needs addressing. Staff have reviewed vibration standards locally and internationally and are recommending a maximum vibration limit be put in place to mitigate the impact of excessive vibrations on nearby structures when vibrations are anticipated from a construction site.

It is recommended that a process be put in place to ensure the issue of vibration is addressed early in the planning process and that the identified notice and complaint handling process be endorsed.

Purpose

The purpose of this report is to respond to Council's direction for staff to provide recommendations and approaches to address the issues identified to protect neighbouring sites from the effects of vibrations from adjacent construction projects and to recommend notice requirements and a complaint handling process.

Background

The Town has received concerns and complaints related to vibrations as a result of nearby construction activities.

Council at their March 26, 2018 meeting made the following recommendations:

1. That the deputation by Stuart Hoffman regarding vibration control in regards to construction activity be received and referred to staff for review and report; and,

2. That staff be directed to provide recommendations and approaches to address the issues identified to protect neighbouring sites from the effects of vibrations from adjacent construction projects; and,

3. That the report should include, but not be limited to, potential by-law changes including the requirement of pre-condition surveys, effective monitoring and data reporting, resident notification and a process for complaint handling in all site plan approvals.

Discussion

The Town's geotechnical consulting engineer, Soil Eng., has provided information related to construction vibrations to assist staff in addressing the issue.

Construction activities such as soil compacting, excavations, moving heavy machinery, etc., can cause ground borne vibrations and where these activities are undertaken near existing developed areas, they can physically be felt by people and minimal movement of structures can occur. If these vibrations reach a significant level, structural damage may occur on neighbouring buildings.

Construction induced ground vibrations causes movement in the particles within the ground and it is measured by the velocity of those particles (Peak Particle Velocity (PPV) in millimeters per second (mm/sec)). The impact of vibration on individuals is subjective and will vary with each person as there are many factors that can influence human tolerance. Because of this, it is difficult to define what would be considered a nuisance. In most cases, construction vibration does not cause structural damage, but

still causes discomfort and inconvenience to residents neighbouring the construction site, even when the vibration level is below prohibited levels.

Vibration in the range of about 0.6 to 1 mm/sec will be felt by most people, and objects inside a house may be disturbed, particularly loose objects such as framed pictures on walls, cabinet doors, chairs, tables and glass in the windows. While this may have nearby residents concerned about potential damage to their property, and complaints may be filed, this level is below the level that could cause structural damage to buildings.

The City of Toronto studied the issue of construction vibrations in 2007 noting that the impact of vibrations on buildings as follows:

The predominant concern related to the impacts of vibrations on buildings are related to cosmetic cracking. The construction techniques on the interior walls of older buildings used wood support covered in thick plaster. Modern construction used drywall with paint or wallpaper. The likelihood for cosmetic cracking in older buildings is greater than modern buildings.

They also note that structures made from masonry or concrete would only crack by vibrations consistent with a blast or earthquake.

The city of Toronto report indicates that: *the research conducted for Toronto Building on construction related vibration in the City of Toronto concluded that the establishment of precise or universal criteria that define vibration thresholds is difficult. Doing so would depend on a myriad of factors related to the nature of vibrations including the source, geologic characteristics, and sensitivity of people near the source, among others. There are site specific characteristics that are likely to be unknown prior to consideration of individual sites. As a result specific criteria for construction vibrations would be an estimate of many factors.*

To prevent unnecessary disputes between developers and residents, an assessment can be undertaken prior to construction activities to determine a “zone of vibration Influence” based on the various construction activities required. This will identify the area surrounding the site that may be subject to vibrations. This study will identify the number of existing structures that need to be surveyed by way of a pre-construction inspection for existing flaws such as foundation cracks, drywall cracks, etc. before construction begins and/or identify the number of houses, if any, that require vibration monitoring during construction.

Vibration monitoring provides a record of the ground vibration induced by construction equipment and encourages contractors to stay below a set limit in order to mitigate the potential for damage. Informing the property owners around a construction site about the construction activities would also be of value.

Updated Process

Currently, with applications for development, a geotechnical report is required which assesses the soil profile and ground water information for the proposed site. To ensure that vibration issues are addressed at the early planning stages of a proposed development, as part of the pre consultation process, staff will confirm with property owners and their consultants the requirement for the geotechnical report to include a section on vibration impacts and proposed mitigation techniques. Staff will also include this requirement in future draft plan conditions of approval.

There will be a requirement that the Geotechnical Engineer will review and comment on the need for pre-condition surveys and vibration monitoring during construction. In the event proposed construction activities include deep foundations, impact pile driver, drilling caissons, soil compaction, large scale earth works (using heavy machinery like bulldozers, loaders, excavators and scrapers) and other construction activities that have the potential to cause vibration, the report will include a minimum zone of vibration influence of 30 metres of the site's property line, identifying all properties within this zone. Where vibrations are expected on neighbouring properties, all properties within the zone will contacted by the developer requesting the owner permit a pre-construction survey to be done. Residents within the zone of influence will also be provided notice prior to any activities occurring that may cause vibrations. The report will also identify any at risk structures within the zone of influence that may be more susceptible to vibration issues such as homes with stone rubble foundations and/or plaster and lath wall finishes. The report will make recommendations on whether or not vibration monitoring is required/recommended based on the review of these structures.

Maximum vibration limits

As noted in the above discussion, a rate of 0.6 to 1.0 mm/sec can be felt by most people, however is too low to cause damage to buildings. While there is no standard ground vibration limit in Canada, it is generally accepted internationally that ground vibrations should not exceed 5mm/sec. There is no precise level at which damage begins to occur. The damage level depends on the type, condition, and age of the structure, the soil conditions, and the frequency of the vibration, however, the below recommend vibration limits represents an accepted standard that should provide the desired protection.

Staff are recommending the Town set the maximum vibration limits consistent with the international standard of 5mm/sec. for a typical wood framed structure with drywall finish which would be considered a Type 2 structure in the below chart. An older home with stone rubble foundations and plaster and lathe wall finishes would be considered a Type 3 structure which has a lower tolerance to vibration. Staff recommend a 3 mm/sec. limit for these types of structures. At these rates, vibrations are unlikely to cause cosmetic cracking in drywall, plaster and unreinforced masonry. The required vibration review will discuss the soil characteristics within the zone of influence to determine if the lower limit is necessary for any site specific development.

Type of Structure	Vibration limit at the foundation
1. Dwelling with concrete foundations, wood framed, drywall finish or equivalent	5 mm/sec
2. Structures that are particularly sensitivity to vibrations due to their age or construction technique	3 mm/sec

In an effort to reduce complaints, staff will require the developer to provide notice to the community prior to conducting activities that cause vibrations. Coupled with a pre-conditions survey, homeowners should be adequately informed of the potential impacts and the process to have issues addressed.

Notice and Complaint Handling Process

Similar to the City of Toronto, staff are proposing the following process regarding providing notice to residents and handling vibration complaints:

At least one week prior to the commencement of construction activity that may cause vibrations, the applicant will notify the ward Councillor, staff and owners and occupants of properties within the zone of influence of the scheduled construction activity.

The notice will include:

- An explanation of the proposed construction activity and its potential to produce vibrations
- The statement of the levels of construction vibration that are prohibited
- The address of the construction site where the construction activity will occur
- The date and time that the work will occur
- The name, address, telephone number and other contact information through which the person affected by vibrations may contact the applicant and the person carrying out the construction activity for the applicant
- Contact information for Nonmarket staff assigned to the project.

In the event the applicant receives a complaint or is otherwise notified of a complaint about vibrations from the construction activity, at the direction of the Town, the applicant shall cause the professional engineer monitoring the project to immediately perform vibration measurement at the complainant's location during activities representative of the offending operation and to provide to the complainant and to the Town staff assigned to the project a copy of the measurement results including an interpretation by the professional engineer of the possible impacts such construction vibrations might have on the building or structure of the complainant; and

In the event that the measurements at the complainant's location exceed the limits set out by the Town, all construction activity generating the vibrations shall immediately cease and not resume until mitigation measures are implanted to reduce the vibration levels so that they are below the limits set out by the Town.

Municipal Review

Over the course of the review, staff contacted numerous municipalities to determine how they deal with vibration issues from construction activities in their communities.

Of the responses, it appears few municipalities (with the exception of the City of Toronto) have standard requirements for vibration considerations and only require review when a development proposal is in proximity to a rail line.

Conclusion

To address the issues of impact of construction vibration on properties in proximity to development, staff are recommending that a process be put in place for new development proposals which requires a report from a qualified professional identifying a zone of vibration influence and recommending a course of action to ensure existing residents in the vicinity of the activity are adequately protected though the use of notices, pre-construction surveying and monitoring.

Business Plan and Strategic Plan Linkages

Creating new policy as it relates to mitigating impact of vibration from construction activities on neighboring communities supports the Town Vision by developing process that assist in protecting communities from adverse development impacts.

Consultation

N/A

Human Resource Considerations

N/A

Budget Impact

There is no direct budget impact as a result of this report.

Attachments

None

Approval

Commissioner, Development & Infrastructure Services

Director of Planning & Building Services

Director of Engineering Services

Contact

For more information on this report, contact: Dave Ruggle, Senior Planner – Community Planning, at druggle@newmarket.ca