Sweden's struggle to modernize its daylight regulations

Paul Rogers, BAU Architects Sweden

Keywords: *Daylight regulations, building codes, daylight factor.*

Sweden is a country which experiences limited duration and intensity of daylight during the winter. Accordingly, Swedish buildings have traditionally been generously daylit. Over the past decade however, there has been a drastic increase in buildings with rooms having daylighting levels well below those mandated by the building code. Without improved legislation for daylight, this trend will continue. This paper: (1) traces the history of Sweden's daylight legislation, (2) identifies the primary factors contributing to the reduction of daylight in buildings, and (3) outlines the ongoing process of modernizing existing legislation. Also discussed are the anticipated consequences of the updated legislation on industry stakeholders. The lessons learned are summarized in general terms applicable to parallel markets in other countries.

The initial failure of Sweden's daylight regulations stem from a lack of clarity in the text of the code coupled with the code's complex manual calculation method for daylight factor. With daylight regulations mired in uncertainty, urban densification, maximization of interior area and increased attention to energy efficiency have acted together to reduce access to daylight. In some case architectural fashion has also had a negative effect. However, the recent trend to environmentally certify buildings has renewed interest in daylight and prompted the authorities to provide much needed clarification of their requirements. Numerous challenges still remain. The first step in solving this puzzle is the creation of a standardized national calculation methodology. A reexamination of internationally accepted threshold values will also be needed to determine if they are acceptable for use at high latitudes. The toughest challenge may be gaining the support and confidence of the industry and those responsible for enforcing the building codes. The support of both is essential to a viable and well-functioning daylight legislation.

Introduction

It is generally accepted that daylight in buildings has the potential to save energy, increase productivity and improve human health. Though science is still working to fully define the full benefits of daylight, there is strong evidence that limiting exposure to daylight has negative effects on human health. As such, access to daylight should be considered a fundamental human right. Sweden is a country where daylight is severely limited in the winter months so providing building occupants with access to it is particularly important. Although a daylight factor requirement has been in place since the mid seventies it has been largely ignored within the building industry. Building regulations exist on the assumption that in their absence, insufficient attention would be given to a particular aspect of importance. An examination of the Swedish context suggests not only that market forces alone are unable to adequately protect people's basic right to daylight and that regulation is necessary, but also that regulations must be thoughtfully composed if they are to be respected.

Background

Sweden's architectural tradition has to a great extent evolved with daylight as a central theme. Electric lighting had come into common use in the 1930s but did not become pervasive until much later. Correspondingly, the building codes through the fifties and sixties made sparse mention of daylight as the country's architects regarded daylight as fundamental design criteria. In response to the looming oil crisis however, the Swedish building code of 1975 began to regulate energy use in buildings and with it maximum allowable window areas. Aware that limiting window size could potentially have adverse effects on daylight in buildings, a minimum point daylight factor of 1% at half room's depth was mandated for housing. Larger window sizes were permissible to ensure that an adequate level of daylight was provided. The calculation method relied on a series of overlays and hand calculations and unfortunately the difficulties in applying the method meant that the daylighting requirement was largely ignored in practice. The legislation was eventually expanded to include all

occupied spaces. Regardless, for 18 years the calculation methods were unchanged and buildings were relatively dark. The 1990s saw a financial crisis grip the Nordic countries and, in response, the Swedish government started a process of deregulation. With the oil crisis seemingly at end and window technologies improving, the building code of 1993 was greatly simplified and restrictions on window size were lifted. In many instances, windows grew well beyond that which is necessary for good daylight. Largely ignored and seemingly redundant, the daylight factor requirement would no longer have specific mention in the text of the code. Rather, a simplified glass to floor area method became the primary method for determining compliance. This method had limitations on glass type, window placement, room shape and surrounding obstructions however. The daylight factor requirement of 1% was still applicable for all other circumstances but unfortunately this policy was apparent in the code only through a chain of outdated references. Few were aware of the limitations of the simplified method and fewer still knew what to do in situations where it could not be applied. Code authorities occasionally checked that a minimum 10% glass per widow area was provided but rarely much else. So as the daylight factor requirement sank forgotten into the shadows of uncertain applicability, the Swedish building code failed to give meaningful regulation on daylight.

Current challenges

There are a number of current market trends leading to reduced daylight access in both new and existing buildings in Sweden. These trends are increased urban density, maximizing of interior space, increasing energy efficiency. The price of land in urban areas has risen drastically in recent years. Additional stories are commonly built atop existing buildings and throughout cities new buildings are inserted into established urban fabrics. Construction costs have risen dramatically and, with the price per square meter at an all-time high, there is an impetus to use every square meter to its fullest. Interior courtyards have often been reduced to mere light shafts and workspaces are frequently placed at great distances from windows. Housing is affected as well. In an effort to reduce the cost of circulation areas, external corridors have become prevalent. Large glazed-balconies are another means by which extra living space can be created but to the detriment of daylight in adjacent rooms. A further threat to daylight is the authorities' focus on reducing energy used for heating and cooling. To comply with increasingly stringent energy targets the industry relies on less transparent glazing, deeper floor plates, thicker exterior walls and a reduction of courtyard and façade glazing. In many instances a number of architectural trends have also worked to reduce daylight. For example, as a way of creating life and rhythm for exterior facades, architects have in recent years frequently designed facades featuring vertical windows placed at irregular intervals. This practice makes for interesting aesthetic opportunities but can present a challenge for daylight. Similarly a general disdain for the appearance of exterior mounted operable sunshades means that glass with lower light transmissions are commonly required. All these trends are expected to intensify and persist for some time. These factors seldom act in isolation and if left unchecked present a serious challenge. Our experience indicates that in Sweden most new buildings have more than one occupied space failing to meet the code's minimum daylight requirement. In many cases a significant percentage of occupied rooms fail to meet the requirement. In these rooms, daylight is commonly less than one-third of mandated levels.

Daylight in the spotlight

Within the last five years, environmental certification of buildings has become common in Sweden. The *Miljöbyggnad* system, with its basis in Swedish standards has been particularly popular. With a mandatory daylight requirement based on the building code, it has been influential in lifting forward quantitative daylight assessment. People in the industry are asking, "What are the rules on daylight?". In response, *Svensk Dagsljusberäkning* (Swedish daylight calculation) was founded in 2010. The purpose of the group is to provide technical support, influence the development and adjudication of daylight credits and test emerging simulation methods. Initially membership was limited and meetings poorly attended. In 2013 however, a discussion group was opened on Linkedin and as more projects attempting certification experienced problems with the daylight,

membership swelled to over 200 members. The group consists mainly of environmental coordinators, engineers, architects, lighting designers and academics. Of this group, five members, through a series of meetings with the authorities, have begun to lobby on behalf of daylight and press for an update of the regulations. As the issue gained momentum, concern grew within the industry that the specter of additional costs and potential legal problems could be on the horizon. In response, an industry funded research paper was commissioned to review the current requirements. The document was completed in May of this year. Since then, a number of magazines have chosen to feature the subject. Daylight is now firmly in the spotlight.

Moving forward

The report makes five key recommendations: (1) Calculation methodology and standardized input values must be set and better documented. In particular, the limitations of the simplified assessment method must be better communicated. A handbook is to be created for this purpose. (2) Daylight factor is to continue to be the primary means for assessing cases which do not meet the criteria for the simplified method, but the current point daylight factor method should be replaced with an average daylight factor. This is partly in order to increase calculation accuracy but also to remedy uncertainties which arise when placing a single calculation point in rooms with complex geometry. (3) The code should not preclude the use of more complex calculation methods such as UDI. (4) The current threshold of a point daylight factor of 1%, though numerically elegant, was never properly tested. Studies of existing buildings indicate that this threshold needs to be reexamined. In order for the legislation to be feasible, the daylight factor requirement may need to be substantially different then that which is considered to be best practice. More study is urgently required. (5) Similarly, today the daylight requirement applies equally to all occupied spaces. This also is too rigid. Rather, a system where thresholds are tailored to building and room function would allow for a degree of flexibility when designing to meet the code.

Conclusions

With limited daylight during the winter months and a booming construction market, Sweden provides a particularly compelling case in favor of daylight regulation. The experience gained from Sweden's struggle to forge a functional legislation provides guidance to other countries looking to protect access to daylight for their citizens. Daylight regulation must be accessible and understandable to be successful. Furthermore, calculation results need to be verifiable. Daylight regulations are prone to conflict with a number of powerful market forces which commonly act in chorus to present a particularly complex challenge. Environmental building certification and fostering communication between industry stakeholders are key to keeping daylight on the agenda. It is important not to confuse building codes with 'best practice'. Realistically, regulations need to be set at a level which are economically viable and as such forethought and compromise are essential.