The current situation

and future outlook of the use of natural stone

Martti Muinonen, Senior Lecturer, Architect, Saimaa University of Applied Sciences
Ilkka Paajanen, Senior Lecturer, Architect, Saimaa University of Applied Sciences

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Introduction

This report discusses the current situation and the future outlook of natural stone in construction. Moreover, the report presents and analyses the Webropol survey *Luonnonkiven käyttö rakentamisessa Suomessa* ('The use of natural stone in construction in Finland') used in compiling the report, as well as its outcomes.

The report is part of the project *Efficient use of natural stone in the Leningrad region and Southeast Finland*. The project is co-funded by the European Union, the Russian Federation and the Republic of Finland.

One activity of the ENPI project is to study the current situation and future outlook of the use of natural stone in Southeast Finland and St. Petersburg area. The area discussed in this report covers the cities of Helsinki, Kuopio, Kotka and Lappeenranta. The use of stone in construction has been limited to house construction and infrastructure construction, as well as park, green space and environmental construction. Moreover, the use of stone in house construction has been limited to facades of buildings.

It is difficult to study the use of natural stone in construction through statistics by construction site, volume or completed output. Data related to the use of stone is mostly available on the volume and number of staff from the stone industry. Based on the current situation, it is difficult to predict the future outlook of the use of stone. Consequently, we drew up an online survey in order to gain an overall understanding about the current situation of the use of stone in the abovementioned towns. In the same survey, we aimed to study the future outlook of the use of natural stone and new stone innovations.

When studying the use and the development of building stone, it is good to briefly review the current situation of construction and the use of stone for construction in Finland. The review is based on statistics and a variety of indicators. Construction statistics are based on statistics from the Ministry of Finance, Statistics Finland and the Confederation of Finnish Construction Industries RT (CFCI). It is reasonably difficult to get statistics from some subareas of the use of building stone. Building stone statistics are based on study outcomes and assessments presented in the publications of the Finnish Natural Stone Association, INFRA association, the Confederation of Finnish Construction Industries RT (CFCI) and VTT Technical Research Centre of Finland.

Construction in Finland

The global economic outlook has changed slightly more optimistic as developed countries are leading the slow recovery. There are some signs pointing to an improvement in the Finnish economy. The GDP forecast for this year is slightly positive. Weak economic trend continues in construction for the third year running and it is estimated that the overall construction volume will decrease by approximately one per cent from the 2013 level. It is estimated that there will be some more new construction projects started. The growth of building costs has evened out.

The trend in construction will continue slightly negative for the next few years. New construction decreased by a little over eight per cent last year. The decrease was the greatest in office and facility construction, where new construction decrease by over one fifth from the first part of the year.

Renovation construction continued to grow at steady 2–3 per cent rate and surpassed the volume of new construction.

This year, the situation for construction will not become much better even though the worst seems to be over. Consumption opportunities of households are weak due to moderate salary decisions and increased taxation. Trust in the economy continues to be at a low level among both consumers and the industry. Mortgages taken out by households have decreased, which significantly affects dwelling construction.

In 2013, the construction of approximately 27,800 new dwellings was commenced while the number of the construction of new dwellings in 2014 is estimated to be approximately 26,500 dwellings. Sales of new dwellings have slowed down particularly outside the Helsinki metropolitan region. The weaker household sales have been partly replaced by sales with housing funds. There are significant uncertainties related to housing demand. In the long run, the demand for housing construction in Finland is maintained, for example, by migration to growth centres and the decrease of household sizes. A rapid change in the construction volume (fig. 1) is not expected; the growth is expected to be steady and slow.

It seems probable that construction volume will turn to growth in all sectors next year. It is estimated that house construction will increase by approximately three per cent while the constructed cubic metres are expected to rise from the historically low level to 33 million cubic metres.

The overall volume of building production in Finland in 2013 was UEUR 28.8 billion, of which land and water construction accounted for EUR 6.2 billion. It is noteworthy that over half (EUR 11.4 billion) of the overall volume of building production (EUR 22.6 billion) was renovation construction (fig. 1).

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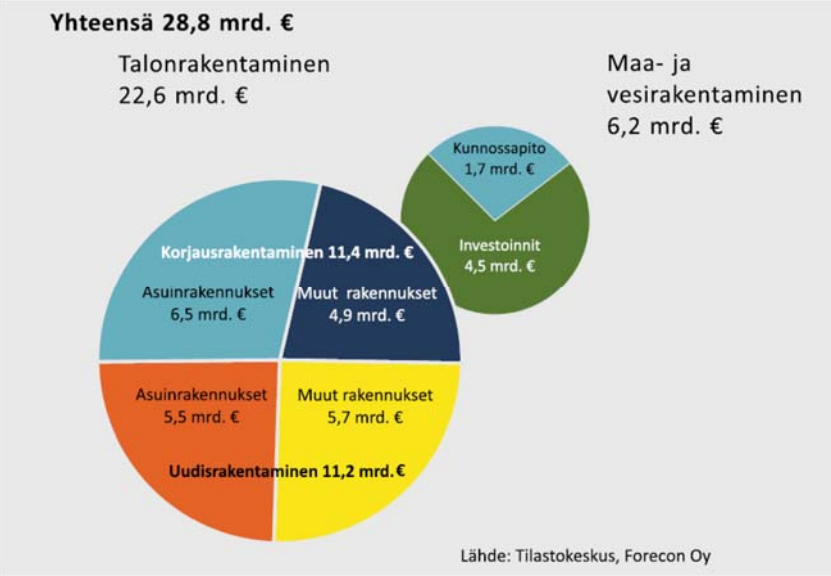

Fig 1. The total value of building production in 2013. (Confederation of Finnish Construction Industries RT)

The near future development of construction should turn positive in 2015 but recovery will be slow (fig. 2). More rapid growth is expected only in renovation construction.

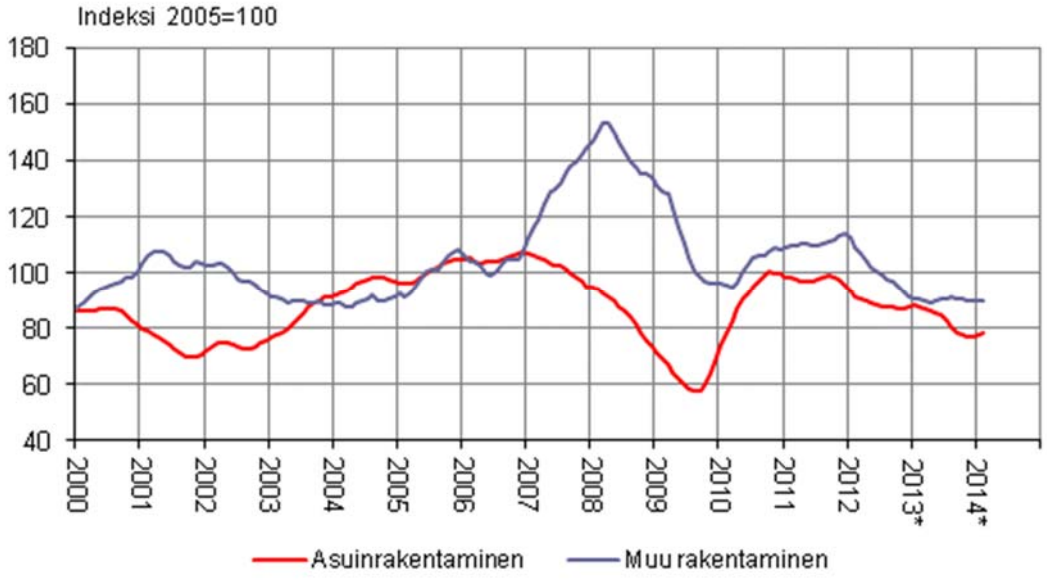

Fig 2. Development of construction volume in Finland. (Euroconstruct, VTT, CFCI)

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Fig 3. Near future development of overall building production. (Confederation of Finnish Construction Industries RT)

Building construction

Some signs of increased activity have been detected in office and facility property markets. The slow economic growth has kept the volume of empty office spaces high. However, there is demand for modern facilities located near good traffic connections. It is predicted that the amount of new office and facility construction projects will start increasing in 2014.

Renovation construction is expected to grow steadily. The growth of building stock is ageing and raising the technical standards to modern levels maintain renovation construction in the future. The situation of infrastructure construction is weakened by the decrease of work related to new construction, as well as to a decrease of investments in channel construction and maintenance.

The growth of GDP in Russia has continued slowing down. The weakened rouble and the crisis in Crimea have increased economic pressures. The raise of the key interest rate decelerates the credit granting and domestic consumption that have kept up the economic growth in Russia. 2014 presents many uncertainties to Russia and the growth of its GDP is expected to be around 0.0–0.5 %. The growth forecast of the Estonian economy has been adjusted down to 1–2 % level.

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Facade construction within building production

Throughout the history, Finnish stone has been used as a material for facade construction. Contemporary architecture increasingly uses wood and metal/glass facades and the use of natural stone is limited primarily to public construction.

Approximately 7–9 million square metres of new facades are built in Finland, which increases the facade stock by approximately 2 % annually.

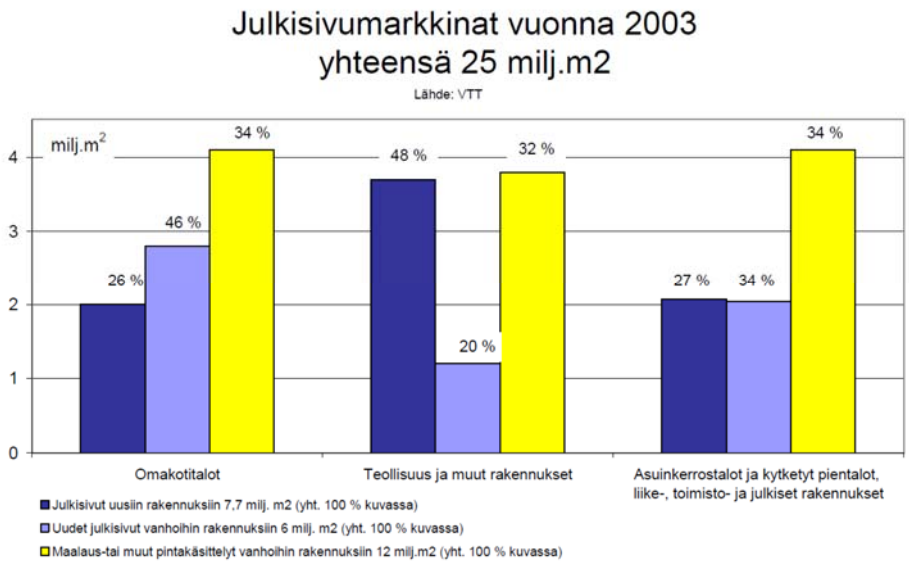

Fig 4. Facade markets in 2003, Finland. (VTT Construction and Infrastructure 2005)

The facade market chart (fig. 4) shows that the share of new facades is large in industrial buildings and other public buildings, while the share of facade renovation is large in detached houses and blocks of flats.

The figure below (fig. 5) presents the construction of new facades in Finland. It shows that wood and concrete are the most commonly used facade materials. The share of stone facades has not changed much and the share of stone as facade material is small.

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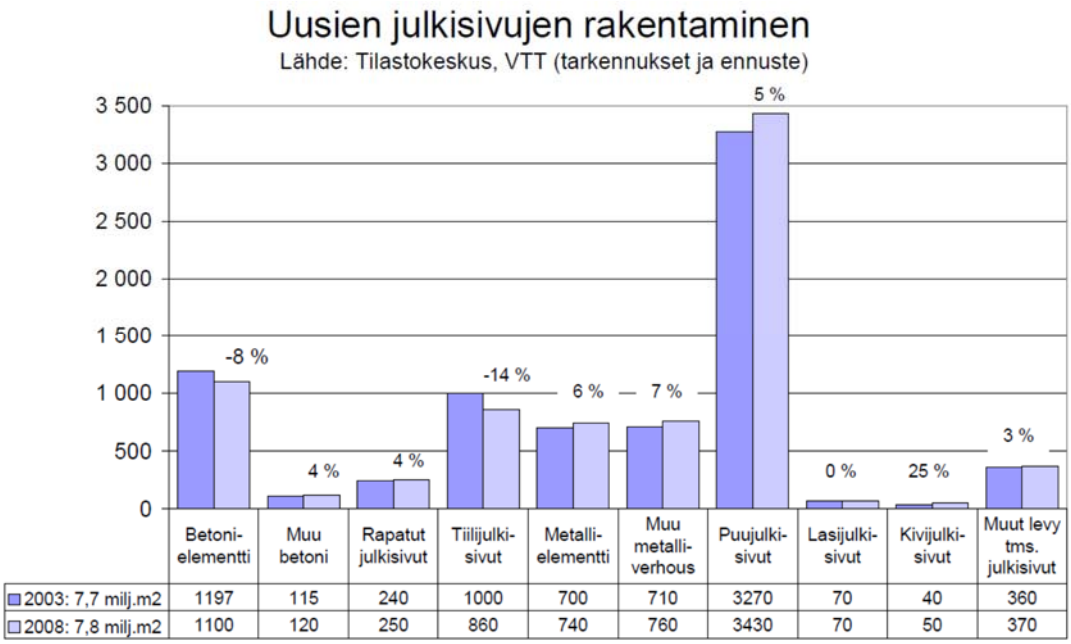

Fig 5. Construction of new facades, Finland. (VTT Construction and Infrastructure 2005)

Stone facades are used in the construction of public facades only to the amount of 40,000 m^2 annually, which accounts for only 0.30 % of all facades (13,700 m^2). The share of stone as a facade material is quite small. The statistical data is reasonably old (VTT, Tampere 2005) but it is indicative.

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UUSIEN JULKISIVUJEN RAKENTAMINEN JA
PURKAVAT/PEITTÄVÄT JULKISIVUKORJAUKSET

	Julkisivut uusiin rakennuksiin 1000 m²		Uudet julkisivut vanhioihin rakennuksiin 1000 m²		Yhteensä 1000 m²	
Betonielementti	1 200				1 200	
Muu betoni	120		190		310	
Rapatut julkisivut	240		570		810	
- eriste + 3-kerrosrappaus		20		130		150
- eriste + ohutrappaus		15		150		165
- 3-kerrosrappaus		30		160		190
- ohutrappaus		170		130		300
(- paikkaukset			250		250)	
Tiilijulkisivut	1 000		460		1 460	
Metallielementti	700				700	
Muu metalliverhous	710		550		1 260	
Puujulkisivut	3 270		4 070		7 340	
Lasijulkisivut	70				70	
Kivijulkisivut	40				40	
Muut levy tms. julkisivut	360		130		490	
Yhteensä	**7 700**		**6 000**		**13 700**	

Fig 6. Construction of new facades. (VTT Construction and Infrastructure 2005)

There is a great deal of competence related to the use of natural stone in facades and there are ready-made structural solutions available in the markets that are both functional and aesthetically pleasing. However, the greatest obstacles to an increased use of stone facades are the attitudes of developers and designers, as well as the cost of a stone facade.

Light ventilated wood, plate, sheet metal, plaster or concrete elements are primarily used in Finland in the renovation of concrete element facades and foundation walls, as well as additional insulation external to the outer walls. Competitive stone solutions should be developed to complement these.

Infrastructure construction

In 2011, the total value of infrastructure construction was approximately EUR 6.3 billion; 35 % of infrastructure construction was channel construction, 25 % network construction and the remaining 40 % other land construction. The share of investments was approximately 70 % and maintenance approximately 30 %.

Infrastructure construction clients are presented below (fig. 7). Channel and network construction is mostly developed by public administration and private sector dominates building construction.

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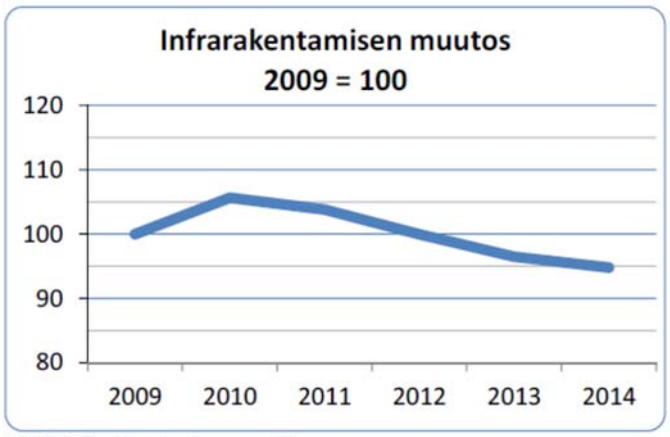

Lähde: Infrarakentaminen muutoksessa

Fig 7. There is a downwards trend in infrastructure construction. Both public and private infrastructure demand are falling with the difficult financing situation in municipalities and central government and foundation engineering in housing construction is decreasing.

INFRARAKENTAMISEN ASIAKKAAT 2011

Taulukko 3 Infrarakentamisen asiakkaat sektoreittain.

	Kunta-konsernit	Valtio	Yksityinen sektori
Väylä-, verkosto- ja ympäristöinvestoinnit	50 %	30 %	20 %
Väylien, verkostojen ja ympäristön kunnossapito	45 %	25 %	31 %
Kaivosalan maarakentaminen			100 %
Uudistalonrakentaminen (alueosat)	15 %	1 %	85 %
Talojen ulkoalueiden hoito	21 %	2 %	77 %
Yhteensä	39 %	21 %	41 %
	3.1 mrd €	1.6 mrd €	3.2 mrd €

Fig. 8. Infrastructure construction clients 2011. (INFRA association Rakentamisen yhteiskunnalliset vaikutukset ['Social impact of construction'])

Landscape and park construction

We did not have statistics for landscape and park construction at our disposal as it is difficult to get a picture about how much stone is annually used in landscape, park and environmental construction by the

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central government, towns and municipalities. According to our Webropol survey, the use of stone is most common in landscape and park construction.

Natural stone markets in Finland

Increasing attention is paid to the principles of sustainable development and the overall economy of construction investments, as well as ecology related to the lifecycle. The use of evaluation methods developed for making comparative assessments about sustainable development and energy efficiency of properties easier is spreading worldwide. In these comparisons, the use of natural stone makes them ecologically more acceptable the longer the buildings are used.

In 2013, the turnover of the entire natural stone industry in Finland was approximately EUR 230 million. In 2012, the volume of the utilisation of stone of total quarrying was approximately 520,000 tonnes, of which hard rock accounted for approximately 400,000 tonnes and soapstone 110,000 tonnes (Finnish Natural Stone Association's statistics).

Hyötykäyttö yhteensä tonneja									
		2005	2006	2007	2008	2009	2010	2011	2012
	Graniitit ja liuskeet	589805	620366	628515	407878	364370	291609	665216	411197
	Vuolukivi	163124	184511	193464	157452	128653	92518	81893	110498
	Yhteensä	752929	804877	821979	565330	493023	384127	747109	521695

Chart 1. The utilisation of stone (in tonnes) in Finland. (The Finnish Natural Stone Association)

Finland is a net exporter of natural stone products. In 2010, the export exceeded import five times over. The export of raw stone and end materials accounted for EUR 70 million in 2010. The value of import was approximately EUR 13.8 million. The share of export of the total turnover of natural stone industry was 33.6 %.

In 2011, the export of granite blocks in particular grew further. The main export destination is China. The decline of European construction markets for four years running has made export to Europe more difficult.

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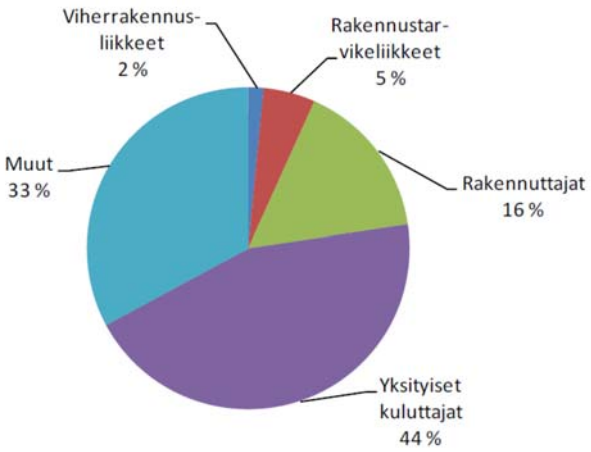

Fig. 9. Client distribution for natural stone in Finland. (Statistics Finland)

In 2010, the turnover of construction stone product group was approximately EUR 150 million and the most significant product in this group were floor stones, which accounted for approximately 30 %. Growth is expected in the product group of decorating and landscaping stones.

In 2010, the turnover of landscaping stone product group was approximately EUR 90 million and the most significant product in this group were floor stones, which accounted for approximately 25 %. Growth is expected particularly in the product group of landscaping stones.

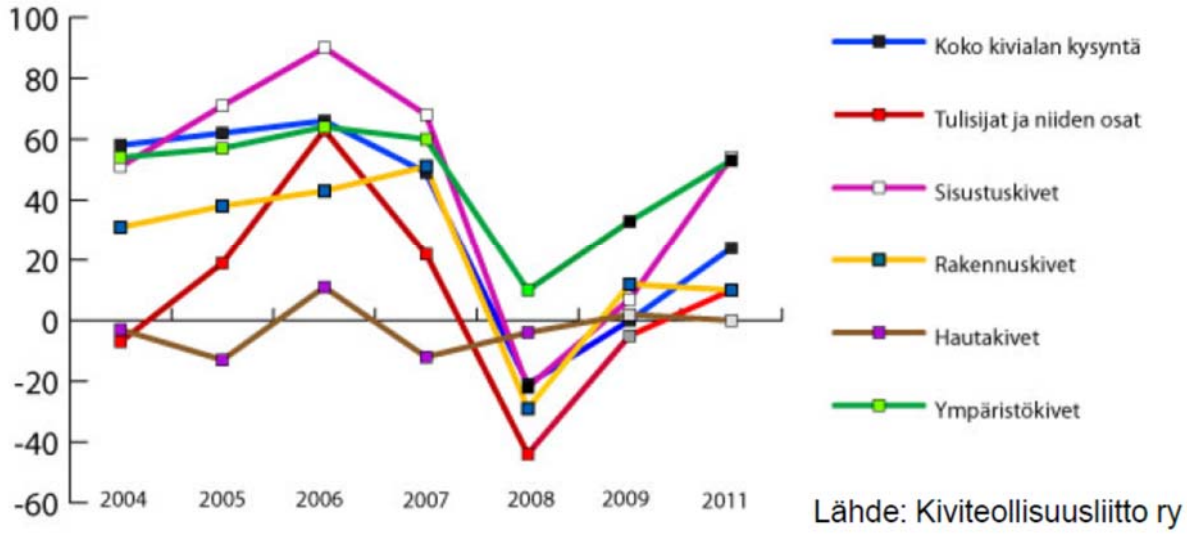

Fig 10. The trend is upward in the use of stone in construction. (The Finnish Natural Stone Association)

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In the long run, steady growth is expected in the stone industry. Finnish domestic stone markets are small and sensitive to trends. Considering the economic situation in Europe, big and sudden growth is not in sight. Expectations are mostly directed at renovation construction and the increase in the use of stone for decoration. Steady growth is also expected in the future from landscaping stone. Competition in stone markets is stiff particularly on the part of the Chinese stone industry.

Background to our Webropol survey

Taking into account the market situation for construction and use of stone described above, we drew up a Webropol survey. The aim of the survey was to first find out about the current situation of the use of stone in Finland and in our target towns, which were Helsinki, Kotka, Kuopio and Lappeenranta. We sent the survey to the largest developers, design agencies and construction companies operating nationwide, as well as planning, monitoring and permit authorities in the target towns.

The target group was individuals, who according to our assessment, could affect the choice of construction materials and consequently, the choice and use of natural stone in construction. This means primarily design directors, designers and inspection/control authorities.

Our survey was divided into three major groups:

1. The respondent's job description and work organisation
2. The use of stone in construction in Finland
3. Stone as a building material.

In the section “Stone as a building material”, we tried to find out the characteristics of natural stone from the perspective of designers and developers and tried to come up with an understanding about the future outlook regarding the use of natural stone and new stone innovations.

In our survey, construction was divided in three main groups

1. Building construction
2. Infrastructure construction
3. Park and landscape construction.

In building construction, the use area of stone was limited to the facade and foundation wall use of buildings. It did not include decorative stone or fireplaces.

In infrastructure construction, the main focus was on channel and street construction.

Park and landscape construction here refers to public parks and recreational areas.

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Our survey was not sent to the stone industry, stone industry sales organisations, contractors or users of the buildings/built environment.

Webropol survey with its questions

The link to the Webropol survey was sent to selected individuals by e-mail and they were given approximately one week to answer it. 205 questionnaires were sent and 30 answers were received, which meant that the response rate was fairly poor at 14.6 %. One could consider reasons for the bad response rate:

1. General fatigue with e-mail surveys
2. Bad timing in amidst the busy May season
3. The questionnaire was reasonably laborious and extensive (23 questions)
4. The subject was not, or it was not felt, to be interesting

Due to the laboriousness and in-depth approach of the survey, it was sent only to construction professionals and true decision-makers. The survey aimed at getting clear answers.

Itemised results of the survey are presented below. Under each question, there is a summary or a comment by the author related to the job description of the project. The final summary of the survey is presented in the conclusion.

1. My work organisation is

Central government (‘valtio’)

Municipality (‘kunta’)

Private (‘yksityinen’)

Other (‘joku muu’)

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As is evident, the survey was targeted at individuals affecting the use of stone in various developer and planning organisations. The main group of the respondents was made up of individuals employed by private designers or design organisations while municipal and central government organisations made up the next largest group in accordance with the selected target group.

2. The name of my work organisation is

As announced by respondents to the survey:

University Properties of Finland Ltd.

City of Kotka

Town planning / land use planning

Saimaa University of Applied Sciences

SRV Construction Ltd.

S-K

Innovarch Ltd.

Siluc Ltd.

City of Lappeenranta/Technical department/Real Estate Department

North Savo Centre for Economic Development, Transport and the Environment (ELY centre)

City of Lappeenranta, building inspection

Sito Ltd.

Finnish Transport Agency

City of Kotka

KVA Architects Ltd.

Vuorinen Architects Ltd.

Construction Establishment of Defence Administration

Skanska Infra Ltd.

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Cityof Kotka / Parks department

City of Lappeenranta, building organisation

Skanska Talonrakennus Oy

Lappeenranta parish union

City of Kuopio, urban environment services area, planning services

Lemminkäinen Infra Oy

City of Kuopio

Ismo Heikkinen

Lujatalo Oy

Lappeenrannan Yritystila Oy

Regional Council of South Karelia

Pöyry Finland Oy

Riitta and Kari Ojala Architects Ltd.

City of Lappeenranta, real estate department

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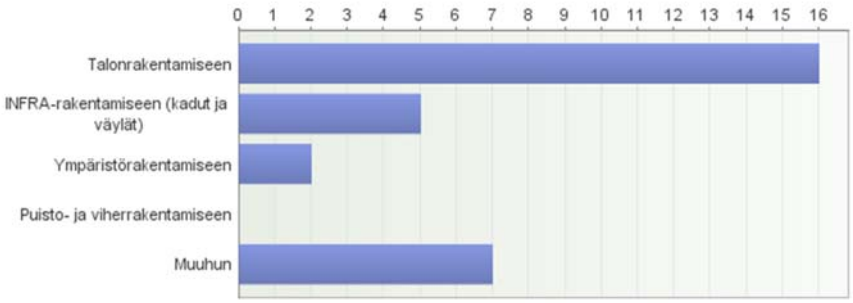
3. My job description is related to



building construction (‘talonrakentamiseen’)

Infrastructure construction (streets and channels) (‘INFRA-rakentamiseen/kadut ja väylät’)

Environmental construction (‘ympäristörakentamiseen’)

Park and landscape construction (‘puisto- ja viherrakentamiseen’)

Other (‘muuhun’)

Over half of the respondents worked in building construction, which is also reflected in the survey outcomes.

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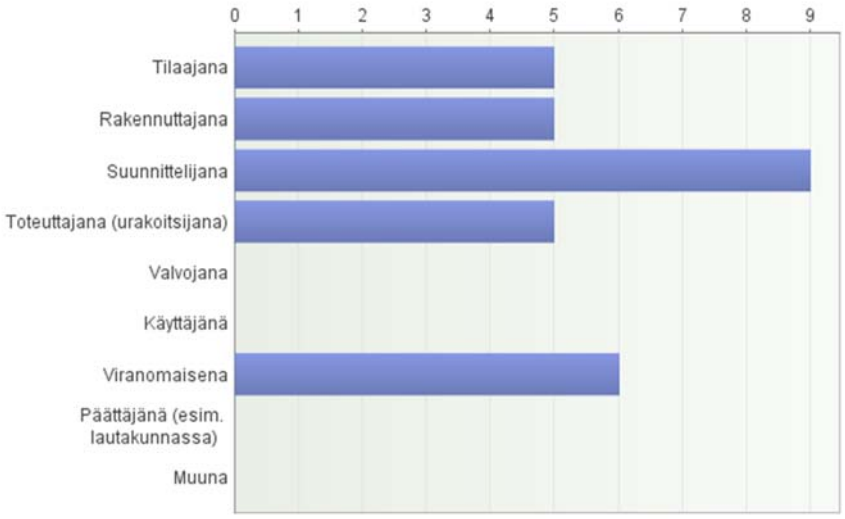
4. I work as a



commissioning body (‘tilaajana’)

developer (‘rakennuttajana’)

planner (‘suunnittelijana’)

implementer (contractor) (‘toteuttajana / urakoitsijana’)

controller (‘valvojana’)

user (‘käyttäjänä’)

authority (‘viranomaisena’)

decision-maker (for example, in a committee) (‘päättäjänä / esim. lautakunnissa’)

other (‘muuna’)

The majority of respondents worked as planners in various organisations. The share of authorities is also large as indicated by the answers to question one.

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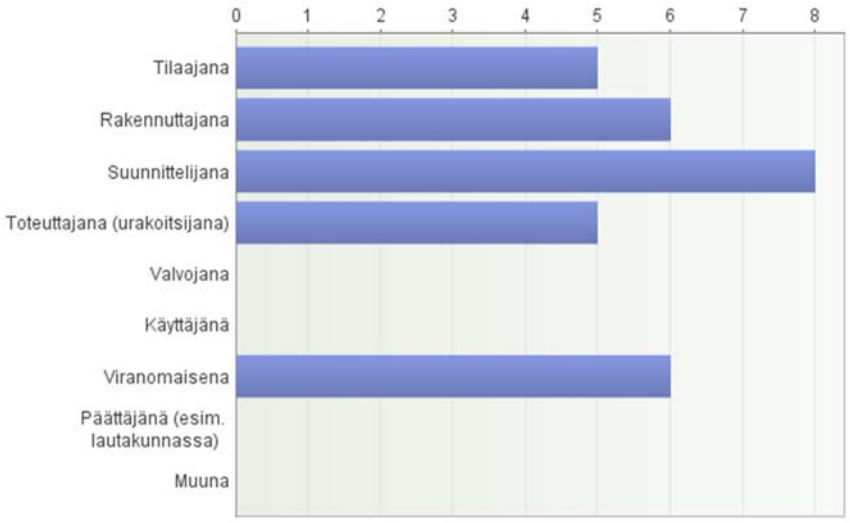
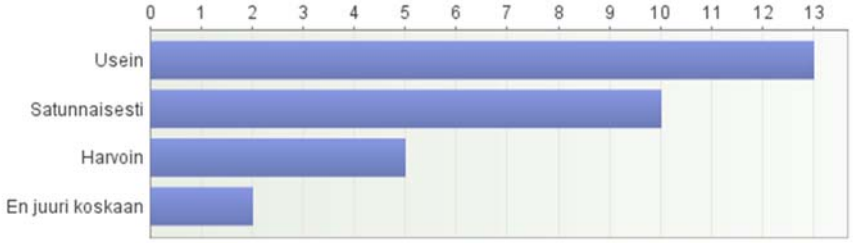
5. I can affect the use and selection of stone in sites



Use and selection opportunities of stone were divided according to work organisations and duties.

6. In construction, I deal with stone materials



often (‘usein’)

occasionally (‘satunnaisesti’)

seldom (‘harvoin’)

hardly ever (‘en juuri koskaan’)

Of all the respondents, 43 % dealt with stone materials often and approximately 6.5 % of the respondents had nothing to do with stone.

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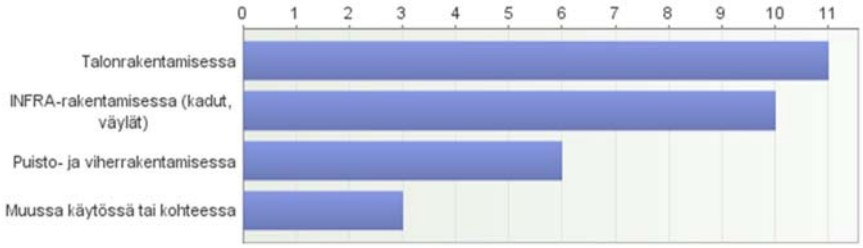
7. Last time I used stone in



building construction (‘talonrakentamisessa’)

Infrastructure construction (streets and channels) (‘INFRA-rakentamisessa / kadut, väylät’)

park and landscape construction (‘puisto- ja viherrakentamisessa’)

other use or site (‘muussa käytössä tai kohteessa’)

People who had last used stone were divided according to job description and work organisations so that there were eleven building construction sites (36.6 %) and sixteen infra/park and landscape construction sites (approx. 53 %).

8. On my last site (question 7), stone was used

in building construction, stone was mostly used as courtyard surfaces and support walls. Stone was used in the facade in only one instance. In infrastructure and park and landscape construction, natural stone was primarily used as street and curb-stones and surface materials for streets.

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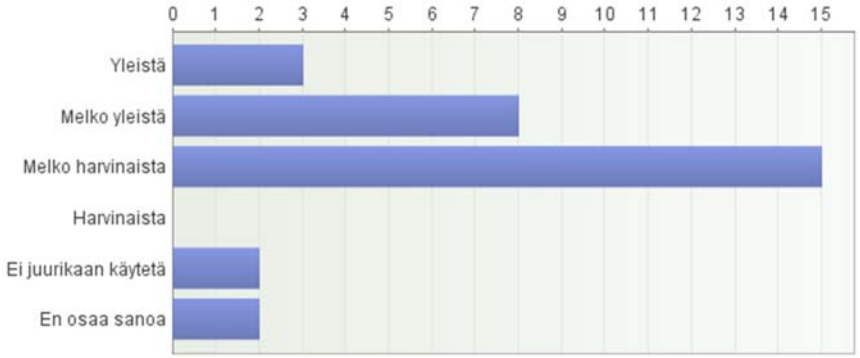
9. In my opinion, the use of stone **in building construction** in Finland is



common (‘yleistä’)

quite common (‘melko yleistä’)

quite rare (‘melko harvinaista’)

rare (harvinaista’)

hardly used at all (‘ei juurikaan käytetä’)

I don't know (‘en osaa sanoa’)

Only ten per cent of the respondents felt that the use of stone was common in building construction. Based on the survey, the use of natural stone in building construction is typically seen as quite rare (50 %). This is also evident in the built environment and cityscape. Stone continues to be a fairly rare material in normal building construction. On the other hand, in public building construction, natural stone is used quite commonly.

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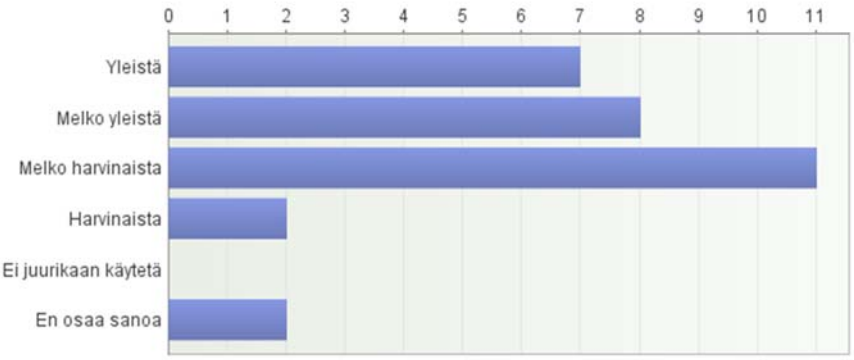
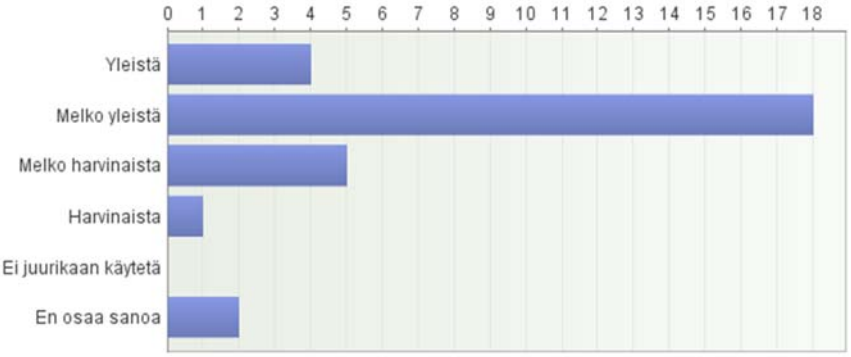
10. In my opinion, the use of stone **in infrastructure construction** in Finland is



The use of natural stone in infrastructure construction is felt to be common (23 %) and clearly more common than in building construction (10 %). Approximately half of the respondents felt that the use of stone is common or quite common in infrastructure construction. It seems a bit odd that 36 % of the respondents felt that the use of stone in infrastructure construction is quite rare.

11. In my opinion, the use of stone **in park and landscape construction** in Finland is



The use stone was most common in park and landscape construction. 60 % of the respondents felt that the use of stone is common and 73 % of the respondents felt that it was common or quite common. The use of stone in park and landscape construction is quite common in Finland and clearly on the rise.

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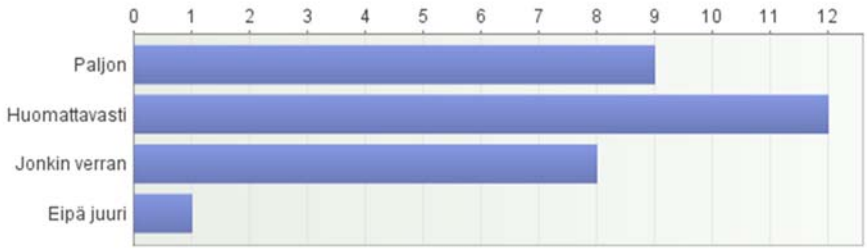
12. Could the use of stone be increased in Finland?



Much (‘paljon’)

Considerably (‘huomattavasti’)

Some (‘jonkin verran’)

Not really (‘eipä juuri’)

The majority of the respondents felt that it would be possible to increase the use of stone in Finland.

13. If yes, where and how? If not, why?

The respondents felt that stone could be used more in the following uses or sites in the order of importance:

1. In all construction
2. In the construction of small houses
3. In the construction of urban spaces
4. In plinths, foundation and supporting walls
5. In facades as a replacement material for concrete
6. In public buildings

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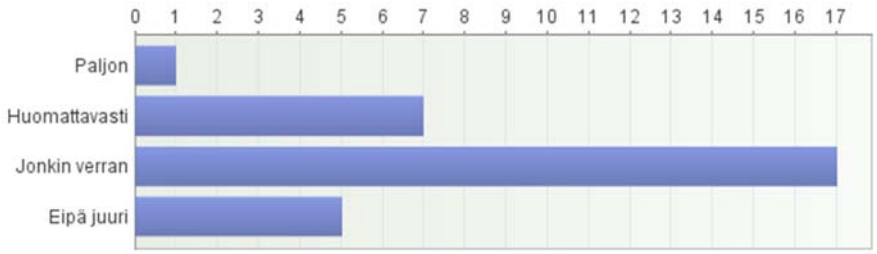
14. Do you believe that the use of stone in construction in Finland will increase in the future?



Approximately 56 % of the respondents believed that the use of stone in Finland would increase somewhat. Consequently, no great invasion of stone is to be expected in the near future considering the slowly rising construction trend in the next few years.

15. In your opinion, what is the main reason for stone not being used?

By far the biggest obstacle to the increase of the use of stone mentioned was the cost of stone and stone labour. The second most common cause was the lack of stone culture and expertise and the third cause highlighted was the image about the price of stone and the difficulty of working with it.

16. Where and how would it be easiest to increase the use of stone?

The easiest way to increase the use of stone is to use it on street and park construction, as well as in public construction:

1. In public construction, both building and infrastructure construction
2. On facades as replacement for concrete

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17. The following images are often linked with stone. Stone is:

	Agree	Somewhat agree	Somewhat disagree	Completely disagree	Total	
domestic	16	12	2	0	30	
traditional	21	5	4	0	30	
beautiful	23	7	0	0	30	
expensive	16	12	2	0	30	
durable	27	3	0	0	30	
work intensive	9	14	7	0	30	
heavy	19	7	4	0	30	
ecological	22	6	2	0	30	
Total	153	66	21	0	240	

Images related to stone are well in line with facts related to the current use of stone. However, experts did not think that stone was too expensive or heavy building material. On the other hand, the fact that stone is a domestic product was not emphasised either.

18. In your opinion, what is the best use for stone?

In the construction of urban spaces, public buildings, plinths and foundations and supporting walls and facades in all construction as a replacement surface material for concrete.

The responses reflect stone's good wear and weather tolerance and the fact that it is a natural material.

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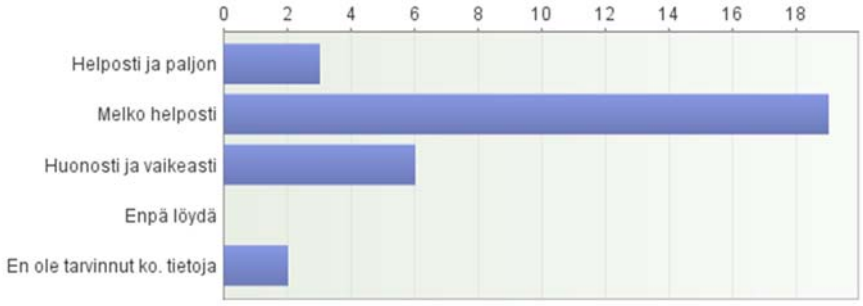
19. What measures could be taken to promote the use of stone?

The following measures were highlighted:

1. Increased training, communications and education (life cycle costs), particularly for developers and planners
2. Marketing and image campaigns (hardware stores, designers)
3. Development of new products (e.g. plinth plates), R&D, mass production
4. Adjustment of pricing

20. In your opinion, is it easy to find information about stone when you require it?



Easy and plentiful (‘helposti ja paljon’)

Quite easy (‘melko helposti’)

Not easy at all (‘huonosti ja vaikeasti’)

Cannot find any (‘enpä löydä’)

I have not needed the information (‘en ole tarvinnut ko. tietoja’)

Information about stone is available but finding it is not self-evident. Only 10 % of the respondents said that finding stone information is easy and 20 % said that finding stone information is not easy at all.

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21. What is the best source of stone information?

Internet (‘internet’)

Traditional brochures (‘perinteiset esitteet’)

Stone industry companies (‘kivialan yritykset’)

Retailers (vähittäismyyjät’)

The Finnish Natural Stone Association (‘Kiviteollisuusliitto ry’)

Stone information is easiest to find on the Internet or materials provided by stone industry companies, so investments in them should be made also in the future.

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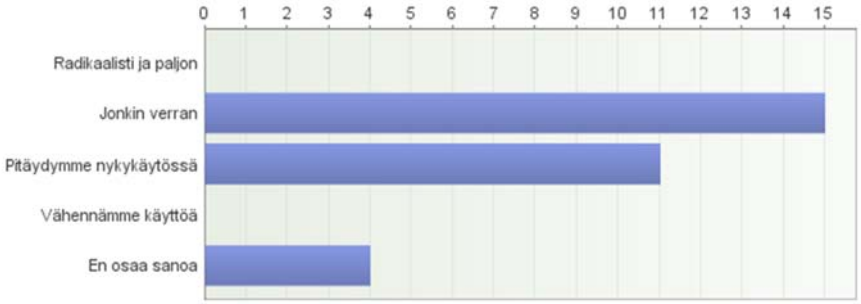
22. Do you think that you will radically increase the use of natural stone in the next ten years?



Radically and much (‘radikaalisti ja paljon’)

Some (‘jonkin verran’)

We will retain the current level of use (‘pitäydymme nykykäytössä’)

We will use less stone (‘vähennämme käyttöä’)

I don't know (‘en osaa sanoa’)

Of the respondents, 50 % said that they would increase the use of stone somewhat, and 36 % said they would retain the current level of use.

23. If you are going to increase the use of stone, what will be the purpose of use or target of use?

Increasing the use of stone corresponds to the answers to the question 18. The use of stone will be increased:

1. In public construction, both building and infrastructure construction
2. In facades as a replacement material for concrete
3. In park and landscape construction, also as a replacement for concrete

In other words, the potential increase of the use of stone is taking place already within traditional stone-building sub-areas.

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Summary and conclusion of Webropol survey

Based on the review of construction and the current situation of the use of stone, as well as the Webropol survey, we have drawn up a summary on the use of natural stone in construction in accordance with the assignment. In addition, we have aimed to study the opportunities and challenges related to the use of natural stone and possible measures that may have to be taken in the future.

It is regrettable that the response rate of the survey was so low and the survey did not provide us with any specifically surprising or new information, let alone new innovations. The conclusions have been collected under a uniform and more extensive theme and we have not gone into details except in cases where they have had more thoroughgoing impact on the survey.

Based on our survey, further measures can be divided in the order of importance in the following main groups:

1. Changing attitudes (mental side)
2. Price policies (financial side)
3. Increasing knowledge and competence (information/skills side)
4. Technical issues and solutions (technological side)
5. New innovations (innovation side)

There is no major increase to be expected in **building construction** in the next few years. Building construction will continue its current trend of slow recovery and growth as the economies of Europe and Finland continue to grow. There does not seem to be much change in sight for the use of natural stone in building construction. Stone will retain its position in public construction and surface interior material. As a facade material, stone will retain its position. Growth should be sought through a change of attitude on the part of developers and clients, and the competitive ability of stone in price competition should be improved. Finnish stone is of high quality both aesthetically and technically but its position in competition is weak. Therefore, the ecological and domestic quality of stone should be emphasised and costs should be regarded as life cycle costs.

The volume of renovation construction has surpassed the volume of new construction in building construction, so the use of stone in renovation construction should be increased. The use of stone should be increased particularly in the renovation of foundation walls and facades. The key role in this is held by developers, architects and other planners.

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Possible measures:

1. Change of attitude among developers and clients: highlighting the image, durability, domesticity and eco-friendliness of stone through campaigns, emphasising naturalness, ecology and design.
2. Development of stone pricing and serial production.
3. Increasing the knowledge and competence of planners. Increasing suitable and well-functioning stone materials, training and knowledge, new mobile applications.
4. Increasing stone knowledge in architect and engineer education (universities, polytechnics, vocational institutes). Preparation of suitable and well-functioning mobile and online teaching material packages and company visits.
5. Development of new stone innovations. Return to massive structures, modular weatherboarding systems, renovation construction systems (renewing facades and additional insulation) and new technology.
6. Increasing the number of contractors, installation crews and professional installers (competitive tendering).

In infrastructure construction, the growth continued slightly negative due to slow public construction demand. In our survey, the use of stone in infrastructure construction was felt to be reasonably rare. Part of the reason may be that infrastructure construction was construed fairly narrowly, even though in our minds it includes at least dams, tunnels, bridges, port structures, noise barriers, wastewater treatment plants, traffic channels, water supply and rock facilities in part. In 2013, the value of infrastructure construction was approximately 21 % of the overall value of construction. In Finland, stone is already used rather extensively in infrastructure construction. One of the great challenges for infrastructure construction will be the problems related to the built environment, one of the biggest ones being traffic noise and its prevention.

Possible measures:

1. Change of attitude among developers and clients. Highlighting the durability, domesticity and eco-friendliness of stone with campaigns. Emphasising naturalness and design.
2. Improving the competitive ability of stone.
3. Increasing the knowledge and competence of planners.
4. Increasing stone knowledge in architect and engineer education (universities, polytechnics, vocational institutes). Preparation of suitable and well-functioning mobile and online teaching material packages.
5. Development of new stone innovations. Utilisation of rock waste, surface materials of traffic areas
6. Increasing the number of contractors, installation crews and professional installers.

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The use of natural stone in landscape and park construction is common in Finland and, according to our survey, the respondents were ready to increase their stone use. The most important use targets included streets, traffic areas, marketplaces and squares and other park construction. Many alternative stone solutions are already available for landscape and park construction. Clear models for the use of waste rock were desired.

Possible measures:

1. Change of attitude among developers and clients. Highlighting the image, durability, domesticity and eco-friendliness of stone through campaigns, emphasising naturalness, ecology and design, replacing concrete with natural stone.
2. Development of stone pricing.
3. Increasing the knowledge and competence of planners. Increasing suitable and well-functioning stone materials, training and knowledge, new mobile applications.
4. Increasing stone knowledge in architect and engineer education, changing attitudes through education
5. Increasing the training and competence of construction material retailers (hardware shops).

The survey did not unearth any stone innovations or revolutionary new technical ideas for using stone. Most of the respondents asked after clear technological systems and well-functioning solutions for details, which already exist in the markets in our opinion. Different kinds of new surfaces for both inside and outside, as well as facade renovation and additional insulation systems are needed.

In public construction, the most common facade materials currently are concrete or concrete mix structure. The current trend in commercial and housing construction seems to be the return to painted and thin-coated concrete sandwich elements, which seems short-sighted considering the Finnish weather conditions and experiences gained as early as the 1970s. Natural stone would provide an alternative for concrete mix structures and buildings would get a more durable and impressive facade. The weakest link of natural stone facades can be considered the seaming. The development and quality assurance of seaming techniques and materials are a necessary condition of increasing the use of stone facades. The safest bet would be to build a stone facade system without seaming materials with continuous joints or tongue-and-groove joints. Correspondingly, a ventilated lightweight and competitive panel shell system, which would allow for normal additional insulation alternatives, should be developed for renovation construction.

The stone industry should offer stone series for the needs of renovation and new construction that are competitive with their pricing and quality through top technology, modern stone dressing methods and robotics. Stone as a construction material should be linked with the construction project as early as the first 3D modelling of the head designer. In this case, the production technology could be linked as a natural part

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to the building's BIM world and the stone supplier would receive the required measurement and number information. In this way, stone would be a natural part of the production chain of the project as a whole.

In discussions with various operators in the stone sector, no new perspectives on promoting the use of natural stone were expressed. The problems recognised in the competitive situation were the price of stone and the small amount of stone-dressing providers (competitive tendering). The surest way of promoting the use of Finnish stone in construction is long-term work on attitudes and communications while highlighting the fact that stone materials are eco-friendly and domestic. Good qualities and the long-term durability of natural stone may be used as an argument for the higher purchase price of natural stone.

If and when the use of natural stone in Finland is increased, the stone industry must ensure that it takes care of its social and environmental obligations. Bad after-care of waste rock or quarries or neglecting it entirely could be a negative signal for people deciding on the use of stone, as well as active environmental organisations. Therefore, we must take particularly good care of the image of stone.

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