

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018

Vertical Forest to Clean Environment

Prof. Rupali Goud¹, Nitesh Kumar Chauhan², Himanshu Lokhande³, Sanjay Bohre⁴

Assistant Professor, Department of Civil Engineering, SVITS, SVVV, Indore, India¹

U. G. Student, Department of Civil Engineering, SVITS, SVVV, Indore, India²

U. G. Student, Department of Civil Engineering, SVITS, SVVV, Indore, India³

U. G. Student, Department of Civil Engineering, SVITS, SVVV, Indore, India⁴

ABSTRACT: Today air pollution is responsible for many health problems in the urban areas. Many metro cities in the world is suffering from air pollution problems. Due to air pollution problem not only humans but animals and birds were also suffering from this problem. This paper provides an idea that how can we reduce pollution from air. The simple way to reduce pollution from air is to grow more and more plants. But in metro cities there were not that much place available to grow plants or trees on land. Therefore we are going to introduce “Vertical Forest By Aquaponics Techniques”. We can grow plants on building balcony by Aquaponics technique. In this we can grow plant without the help of soil. If we grow the plant by Aquaponics technique than due to that there will be less load on building structure as compare to using of soil.

KEYWORDS: Vertical forest, Aquaponics, Air-pollution, Atmosphere, WHO.

I. INTRODUCTION

Today, air pollution has emerged as a global public health problem and is identified as a major environmental health hazard by agencies such as the World Health Organization (WHO) and governments around the world. An increase in concentration of pollutants - both gaseous and solid - is among the largest health risk in the world and according to the latest data released by WHO, indoor and outdoor air pollution were responsible for 3.7 million deaths of people aged under 60 in 2012. In recent years, air pollution has acquired critical dimensions and the air quality in most Indian cities that monitor outdoor air pollution fail to meet WHO guidelines for safe levels. The levels of PPM2.5 and PPM10 (Air-borne particles smaller than 2.5 micrometers in diameter and 10 micrometers in diameter) as well as concentration of dangerous carcinogenic substances such as Sulphur Dioxide (SO₂) and Nitrogen Dioxide (NO₂) have reached alarming proportions in most Indian cities, putting people at additional risk of respiratory diseases and other health problems. Furthermore, the issue of indoor air pollution has put women and children at high risk. Now A Days it's getting difficult to take a fresh breath in the metro cities like Delhi, Mumbai, Chennai etc .It is not possible to reduce air pollution at that level that is not affective to living organisms .In many Cities of India many things are experimented to control air pollution such as:- nearly in all metro cities CNG vehicles are taken in use for public transportation. In Delhi Even-Odd is Adopted, Swachh Bharat Abhiyan and many more but they are not that effective to control over air pollution. This is due to cutting of Forest's, Forest is the house to many living organisms. It is a precious resource provided by nature. The organisms living in forests are interdependent on each other. Life in forests is governed by factors like air, water and sunlight. There is variety of plants available in most forests: herbs, shrubs and trees depending upon the climate of the region. There are many forests spread over large areas across the globe. Forest can be classified as: tropical, ever-green, partly evergreen, deciduous and dry forests based on the climatic conditions and types of trees present. A forest is defined as an area forming an ecosystem.

Likely to the forest we are planning a building consisting of plants and herbs on the elevation of that building. So that building looks more attractive and eco-friendly.

In few countries a new concepts is adopting to take control over air pollution by building a “Vertical Forest” in a mid city. Which help to reduce CO₂, NO₂ & many other harmful gases from the atmosphere, and produce more oxygen. **By Vertical Forest we can provide fresh air to the citizens of that city in which we build the Vertical**

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018

Forest. Vertical forest is the small forest that can be built on a building using less space and making air clean in large amount. Plants can make a building attractive and eco-friendly. This type of building can be used as commercially or residentially. It also reduces the temperature of building. Our paper is also based on this concept. We plan a vertical forest, but in that we are not using soil for plantation. In Vertical Farming Plants can be grown through various methods like Hydroponics, Aquaponics & Aeroponics.

In our Project for “vertical forest” we are adopting & testing on **Aquaponics Method**. In this method insist of soil we directly flow nutrient water to grow plants. Which is totally a new concept in building a vertical forest. By adopting this method we use 60%-70% of less water for plantation. This method is very successful in the field of Vertical farming. Therefore we are adopting.

II. LITERATURE REVIEW

1. BOSCO VERTICAL

The Bosco Vertical in Milan, Italy, support one of the most intensive living green facades ever realized. The combination of its sophisticated plant selection, the deployment of greenery in all orientation, the structural design to accommodate the plants, and the maintenance, safety, and the irrigation system, represents one of the most innovative tall building projects in the recent memory. The Bosco Vertical is completed in the year 2014. The Architect of Bosco



Fig. 1 Bosco Vertical Balcony



Fig. 2 Bosco Vertical Balcony view



Fig. 3 Elevation of Bosco

Vertical is Boeri Studio. The authors of bosco vertical research paper is Elena Giacomello. The Adjunct Professor of Building Technology, Unicersita luav di venezia, Venice, Italy & Massimo Valagussa & Dr. Massimo valagussa is Director of Laboratory MAC Analysis, Minoprio Foundation Milan, Italy. Elena Giacomello Is an architect with a PhD in building technology.

“Artificial Soil: PhD thesis in building technology”.& Dr. Massimo Valagussa in an agronomist with expertise for arboriculture, horticulture & landscaping. He is a scientific and technical consultant manager of the minoprio analisi e certification S.r.l Milano an agricultural laboratory for analysis (soil, growing media, irrigation water, leaves and manure). There project consist of two residential tower, The height of tower D is 85 meters consists of 18 stories and Tower E is 117 meters consists of 27 stories. The building gross floor area is 18,717 sq-m, in which surface area covered by green wall is 10,142 sq-m. In Bosco Vertical tower tree planted cantilevering balconies.

The main aim objective of their project is to reproduce the equivalent of 1 hectare of forest vertically, with the attendant benefits of noise and pollution reduction, shading for cooling and aesthetic enhancement, projecting balconies on each floor and on each face are enhanced by trees and bushes placed in concrete planters which act as parapets.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018

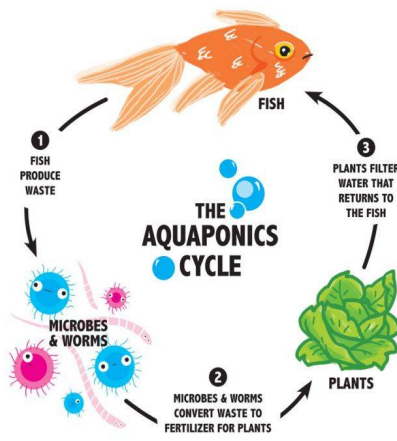


Fig. 4 Aquaponics cycle



Fig. 5 Aquaponics system



Fig. 6 Aquaponics test on tulsi plant

There are about 20,000 specimens and including about 700 trees up to six meter high, installed in a tower. The climate condition of Milan has a humid, subtropical climate that is characterized by hot and humid summers with cold and damp winters. Experiences four seasons and a wide range of temperatures, typically varying from -1°C to 31°C . There is often measurable snowfall from December through February. The remainder of the year consists of rain in spring time and temperatures ranging from 20°C to 30°C during the summer and -1°C to 10°C during the winter.

2. AQUAPONICS

Aquaponics, in which an aquaculture system is integrated with a hydroponic system, also has an ancient history. Plants have been grown using fish farm wastes either directly or indirectly in China and SE Asia for hundreds if not thousands of years.

While Western economies have no such ancient tradition, interest in Aquaponics has been strong since the 1960s, with early work for example in the US at Woods Hole Oceanographic Institute²¹. Since that time there have been many major research projects and programmes throughout the developed and developing world, reinforced by the growing awareness of the need to reduce the impact of nutrient wastes on the environment while at the same time increasing the efficiency of nutrient use in food production. The heightened interest in aquaponics is reflected in the existence of the dedicated Aquaponics Journal which was established in 1997.

Globally there are now hundreds of small scale aquaponic initiatives and several larger scale commercial or near commercial enterprises – the latter mainly in the USA and in particular Hawaii. In parallel with research on aquaponics there has also been substantial research on integrated multi-trophic aquaculture (IMTA) in which fish and plants are grown in more open systems²². The classic examples here are of growing caged salmon in close association with mussel and seaweed cultivation. Despite substantial pilot scale research for well over a decade however, these systems have not been adopted on a significant commercial scale, mainly because of the large quantity and low value of seaweed produced, reduced water circulation around the fish cages, and a range of other management issues.

It is also notable that in parallel with the growing interest in integrated food production systems in the research community, there has been a strong tendency toward reduced “integration” in the ancient heartland of integrated agriculture-aquaculture systems – China – where the economic environment, as in most Western countries, has favoured increased specialization and intensification

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018

III. OBJECTIVE

- Our main Aim of for writing this research paper is to reduce air pollution from metro cities. Our idea is to grow plants on the building balconies but without the help of soil medium. Insist of soil we have used Aquaponics method to grow plants in that we use coco peat and Rockwool as a growing medium. In this method we requires less water to grow the plants. Due to this method there will be less load on the building balconies. Because unit weight of water is less as compare of soil. And plants grow much faster than of compare to soil.
- Due to more plants grown in building due to which they absorb more carbon-di-oxide and release more oxygen. As a result there will be decreasing in air pollution in metro cites.
- These structures have created a positive impact on urban areas. An urban tree house that protect residents from air and noise pollution. The plants that surround the forest-like apartment helps reduce carbon dioxide. That urban areas are most likely to face air pollution than those living in rural areas because of the "CO₂ domes". These "domes" are invisible carbon dioxide clouds that form over an urban area.
- The plants from the vertical forests not only reduce carbon dioxide, but it also helps block sounds and traffic noises that come from the streets. As more vertical forest are designed and build in the urban areas, the structures have shown an ethical solution to the urban environments that face serious air pollution by reducing the carbon dioxide in the air. The noise pollution can be blocked by the foliage of the plants and it has help create a microclimate for those urban areas that face the "heat island effect" by cooling the environment with the plant's evaporation transpiration. This makes the urban area more safer and healthy for those living in it.

IV. METHODOLOGY

1) Aquaponics systems

In Aquaponics the anaerobic (de-nitrification) filter used in RAS is largely replaced with a hydroponic plant production system. If this is a media based hydroponic system it will also serve as an aerobic bio filter, converting ammonia to nitrate. From the plant production perspective, the nutrient injection system normally used in hydroponics is replaced with a fish production/nutrient waste generation system. Part of the nitrogen excreted by the fish is thus taken up by the plants rather than being released to the atmosphere, and the plants also remove a wide range of other nutrients from the water including phosphorus. Of total nitrogen input into the system as feed, up to 30% may be captured as fish flesh, and 40% or more captured as plant biomass. The balance is lost as nitrogen gas or as solids, which may be used to fertilize a garden³¹. Higher levels of nutrient capture may be possible with additional separate biofiltration³². Furthermore, the complex mix of nitrifying bacteria, rhizobacteria, fungi, and micro plankton in the recalcitrated water appears to benefit the plants due to both positive interactions at root level, and the higher resilience of the system against some plant pathogens .

It should be emphasised that most Aquaponic systems – and certainly those that seek to maximise the use of waste nutrients produced by the fish – are dominated by the plant production (hydroponic) component in terms of both area and production. This is quite simply because you need an awful lot of vegetables to absorb the waste nutrients generated by intensively grown fish. Aquaponics systems may include the following components, though not all are required if the system is to be run at low intensity and primarily for plant production.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018



Fig.7 Aquaponics Working model

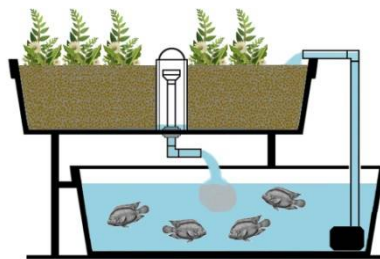


Fig.8: Aquaponics by Picture

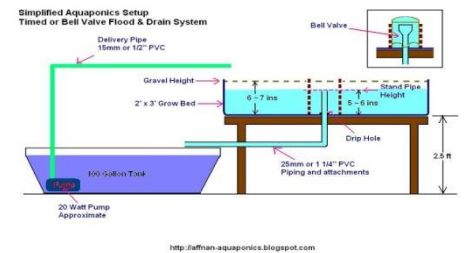


Fig. 9 Explanation of Aquaponics

- Sump
- Fish tank
- Settling tank or clarifier
- Physical filter (which may also serve as an anaerobic, denitrifying filter)
- Aerobic bio-filter
- Degassing unit
- Grow-beds or tanks
- Blower/aerator/diffuser
- Pump

Two extreme examples of Aquaponics systems are shown in figures 7 and 8. A wide number of variants on these basic themes are available and recommended by different manufacturers but will not be described in detail here. A web search will reveal a range of off-the-shelf systems. Fish tanks are typically round in shape to improve water flow and prevent “dead” areas where solids can build up. In almost all systems aeration is provided to optimise conditions for fish (and plant) growth, allow for high stocking densities, reduce the risks associated with water supply failure (e.g. blockage or pump failure), and facilitate nitrification. Stocking densities can be very high dependent on the species, temperature and level/efficiency of aeration. For example Nile Tilapia (*Oreochromis niloticus*) can be stocked at up to 60-70 kg/m³. Carp could also be stocked at similar densities given adequate aeration. In temperate countries trout would thrive at considerably lower densities.

V. TEST PERFORMED

In our paper we have tested Ph and Do of water in which fish is kept. We have performed this test because if DO or Ph value gets low of its average value than in such kind of atmosphere fish cannot survives.

1) pH Test

pH is a measure of [hydrogen ion concentration](#); a measure of the [acidity](#) or alkalinity of a [solution](#). The pH scale usually ranges from 0 to 14. [Aqueous solutions](#) at 25°C with a pH less than seven are [acidic](#), while those with a pH greater than seven are basic or [alkaline](#). A pH level of is 7.0 at 25°C is defined as '[neutral](#)' because the [concentration](#) of H₃O⁺ equals the concentration of OH⁻ in pure water. Very strong acids may have a [negative pH](#), while very strong bases may have a pH greater than 14.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018



Fig. 10: pH Test

2) Dissolved Oxygen

Dissolved oxygen is necessary to many forms of life including fish, invertebrates, bacteria and plants. These organisms use oxygen in respiration, similar to organisms on land.- Fish and crustaceans obtain oxygen for respiration through their gills, while plant life and phytoplankton require dissolved oxygen for respiration when there is no light for photosynthesis. The amount of dissolved oxygen needed varies from creature to creature. Bottom feeders, crabs, oysters and worms need minimal amounts of oxygen (1-6 mg/L), while shallow water fish need higher levels (4-15 mg/L).

- Microbes such as bacteria and fungi also require dissolved oxygen. These organisms use DO to decompose organic material at the bottom of a body of water. Microbial decomposition is an important contributor to nutrient recycling. However, if there is an excess of decaying organic material (from dying algae and other organisms), in a body of water with infrequent or no turnover (also known as stratification), the oxygen at lower water levels will get used up quicker. Important While most photosynthesis takes place at the surface (by shallow water plants and algae), a large portion of the process takes place underwater (by seaweed, sub-surface algae and phytoplankton). Light can penetrate water, though the depth that it can reach varies due to dissolved solids and other light-scattering elements present in the water. Depth also affects the wavelengths available to plants, with red being absorbed quickly and blue light being visible past 100 m. In clear water, there is no longer enough light for photosynthesis to occur beyond 200 m, and aquatic plants no longer grow. In turbid water, this photonic (light-penetrating) zone is often much shallower. Regardless of wavelengths available, the cycle doesn't change. In addition to the needed light, CO₂ is readily absorbed by water (it's about 200 times more soluble than oxygen) and the oxygen produced as a byproduct remains dissolved in water. The basic reaction of aquatic photosynthesis remains:
$$\text{CO}_2 + \text{H}_2\text{O} \rightarrow (\text{CH}_2\text{O}) + \text{O}_2$$
- As aquatic photosynthesis is light-dependent, the dissolved oxygen produced will peak during daylight hours and decline at night.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018



Fig. 11; DO test

3) PROCEDURE

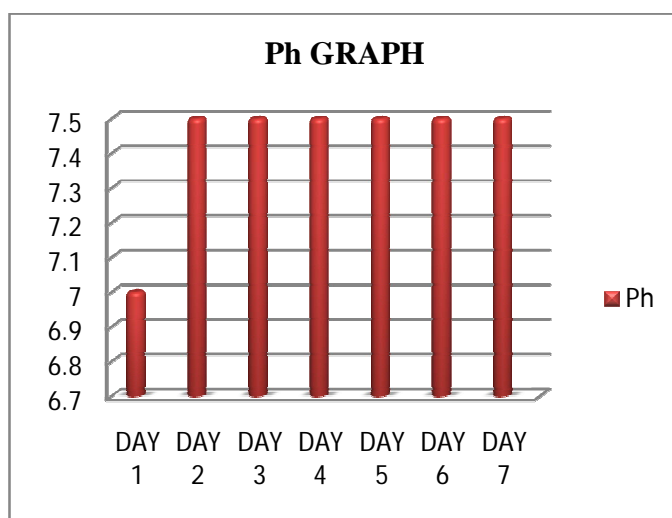
1. Sample is collected in D.O. bottle from source and air bubbles removed.
2. D.O. is fixed by adding 2 ml of each alkali-azide and manganese sulphates solution to the sample filled in bottle water cause interference in desired.
3. These bottle sample are brought to the lab.
4. Sufficient quantity of H_2SO_4 acid is added to D.O. bottle sample. 5. Iodine is liberated from KI. The amount of I_2 liberated is proportional to amount of D.O.
5. 6. 100 ml of solution thus obtained is taken and two drops of starch is added as an indicator.
6. This is treated against sodium thiosulphate and volume of it is noted.

i. OBSERVATION TABLE OF pH TEST FOR 7 DAYS

GRAPH OF pH FOR 7 DAY'S

SAMPLE	VOLUME OF SAMPLE	VOL. OF UNIVERSAL INDICATOR (NO. OF DROP'S)	RESULTS
1	20	3-4	7
2	20	3-4	7
3	20	3-4	7.5
4	20	3-4	7.5
5	20	3-4	7.5
6	20	3-4	7.5
7	20	3-4	7.5

Table -1



International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

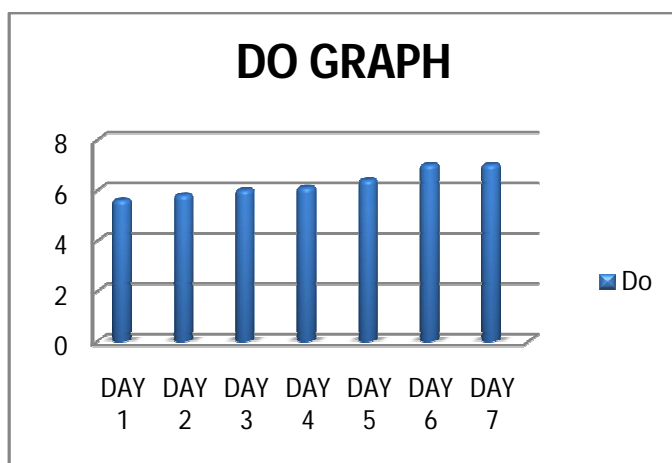
Vol. 7, Issue 3, March 2018

ii. OBSERVATION TABLE OF DO TEST FOR 7 DAYS

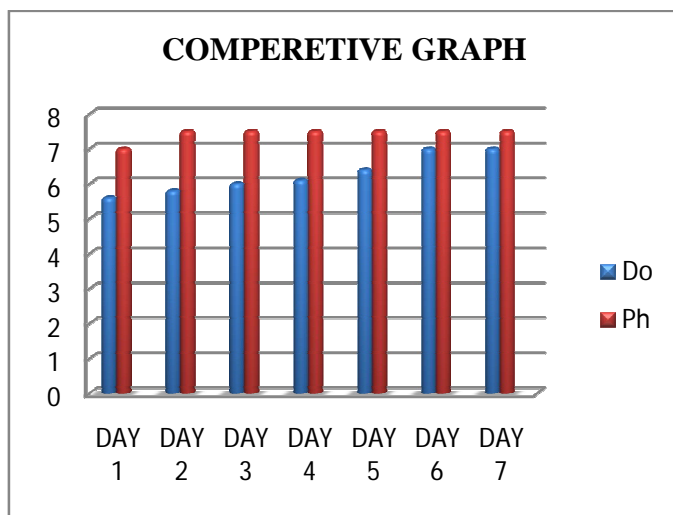
Sample	Volume of Sample	Burette initial reading	Final reading	Volume of sodium thiosulphate required	Dissolved oxygen
1 DAY	300	29.9	35.5	5.6	5.6
2 DAY	300	32	26	5.8	5.8
3 DAY	300	29.5	23.5	6	6
4 DAY	300	30	23.9	6.1	6.1
5 DAY	300	31.2	24.8	6.4	6.4
6 DAY	300	30.2	23.2	7	7
7 DAY	300	29.8	22.8	7	7

Table-2

GRAPH OF DO FOR 7 DAY'S



iii . Combine Graph of pH & DO



International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 3, March 2018

VI. CONCLUSIONS

Aquaponics is a great alternative to the current farming methods and can improve food security. Here are several reasons why this is the case:

- It doesn't rely on soil
- It doesn't depend on low welfare standards
- It doesn't depend on high feedstuff input
- Prolific chemical use to meet margins is not required

Aquaponics mimics biology and can be used on a [small scale in your own backyard](#) or house, and also on a community level which would educate and enable people to grow their own food to benefit many on a personal and economic scale.

- The observation of growth of a plant is simply which are given 2 plant observation on the date conducted 4/10/2017, one of tulsi and other are snake plant which having good condition of plant were alive and vegetated after installing ,growth continuous in the progress new leaves showed in aesthetically good



Fig.12: Tulsi & Snake Plant grown by Aquaponics Method

REFERENCES

1. *Evaluating the High-Rise Vegetation of the Bosco Vertical, Milan*
2. [https://store.ctbuh.org/Previews/Books/2015 Vertical Greenery](https://store.ctbuh.org/Previews/Books/2015%20Vertical%20Greenery)
3. [Google](#)
4. [http://www.google.co.in/india,Aquaponics ,Chandigarh](http://www.google.co.in/india/Aquaponics,Chandigarh)
5. [https://www.youtube.com/channel /UCb9...](https://www.youtube.com/channel/UCb9...)
6. [Aquaponics - Wikipedia](#)
7. [Stefano Boeri designs "vertical forest" city to eat up China's smog](https://www.dezeen.com/.../liuzhou-forest-city-stefano-boeri-proposes-plant-covered)
8. <https://www.dezeen.com/.../liuzhou-forest-city-stefano-boeri-proposes-plant-covered>
9. wiki.nurserylive.com/t/top-9-plants-that-gives-off-oxygen-at-night-as...best.../315
10. https://en.wikipedia.org/wiki/Vertical_farming
11. <https://www.stefano-boeri-architetti.net/en/project/nanjing-vertical-forest/>
12. <https://www.domain.com.au/news/this-eyecatching-vertical-forest-in-switzerland-is-about-to-become-a-reality-20151111-gkwltx/>